JOHN BENASSI (SBN 74137)
DAVID E. KLEINFELD (SBN 110734)
MATTHEW C. LAPPLE (SBN 193546)
SAMUEL R. HELLFELD (SBN 234421)
HELLER EHRMAN LLP
4350 La Jolla Village Drive, 7th Floor
San Diego, CA 92122-1246
Telephone: +1.858.450.8400
Facsimile: +1.858.450.8499
john.benassi@hellerehrman.com
david.kleinfeld@hellerehrman.com
matt.lapple@hellerehrman.com
samuel.hellfeld@hellerehrman.com

Attorneys for Plaintiff
PULSE~LINK INCORPORATED

FILED
07 DEC 21 PM 4:31
CLERK, U.S. DISTRICT COURT
SOUTHERN DISTRICT OF CALIFORNIA
BY: DEPUTY

UNITED STATES DISTRICT COURT

SOUTHERN DISTRICT OF CALIFORNIA

PULSE~LINK INCORPORATED, Plaintiff, v. TZERO TECHNOLOGIES INCORPORATED, Defendants.	Case No. '07 CV 2407 JAH AJB **COMPLAINT FOR DAMAGES AND INJUNCTIVE RELIEF:** **1) FALSE AND DECEPTIVE ADVERTISING (LANHAM ACT 15 U.S.C. § 1125)** **2) UNFAIR COMPETITION AND DECEPTIVE TRADE PRACTICES (CAL. BUS & PROF. CODE § 17200 *ET SEQ*)** **3) INTENTIONAL INTERFERENCE WITH PROSPECTIVE ECONOMIC RELATIONS** **4) NEGLIGENT INTERFERENCE WITH PROSPECTIVE ECONOMIC RELATIONS** **5) FALSE ADVERTISING (CAL. BUS. & PROF CODE § 17500 *ET SEQ*)** **6) COMMON LAW UNFAIR COMPETITION** **7) UNJUST ENRICHMENT** **(DEMAND FOR JURY TRIAL)**

ORIGINAL

Heller Ehrman LLP

Plaintiff PULSE~LINK Incorporated ("PULSE~LINK" or "Plaintiff") for its complaint herein alleges as follows:

I. THE PARTIES

1. Plaintiff PULSE~LINK is a corporation organized and existing under the laws of the state of Delaware, with its principal place of business at 1969 Kellogg Avenue, Carlsbad, California 92008.

2. Defendant Tzero Technologies Incorporated ("Tzero") is a corporation organized and existing under the laws of the state of Delaware, with its principal place of business at 455 West Maude Ave. Ste 100 Sunnyvale, California 94085.

3. Tzero is doing business in California and in this district.

II. JURISDICTION AND VENUE

4. This is an action for, *inter alia*, false and deceptive advertising arising under the Lanham Act § 43(a), 15 U.S.C. § 1125(a) with original jurisdiction vested in this Court by virtue of 15 U.S.C. § 1121. *See also* 28 U.S.C. § 1331 This Court has supplemental subject matter jurisdiction over the remaining state law claims pursuant to 28 U.S.C. §§ 1367.

5. Venue is proper in this judicial district under 28 U.S.C. § 1391(b)-(c) because Tzero has extensive contacts with the State of California and in this judicial district, has caused its products to be advertised, promoted and sold in this judicial district, because the causes of action asserted in this Complaint arose out of those contacts, and because Tzero does business in this district.

GENERAL ALLEGATIONS

6. This action arises out of Defendant's intentional, negligent and ongoing violations of the Lanham Act, the California Common Law, and the California Business and Professional Code.

7. PULSE~LINK and Tzero are competitors in the market of delivering wireless solutions to the home allowing consumers to eliminate the cost and complexity of hard wired connections using Ultra Wideband ("UWB") technology. PULSE~LINK's system allows the use of conventional coaxial cable to deliver non-line of sight operation to high definition televisions and other devices anywhere in the home without the need to tear down walls and run new cabling.

8. Devices enabled with PULSE~LINK's revolutionary "CWave" UWB chipset allow High-Definition ("HD") content located in the home to be shared across the existing coax backbone, and then networked with wireless connectivity for Set-top Boxes, HDTVs, DVRs, DVD players, Gaming Devices, Media Center PCs, and other multimedia equipment. An animation of this system can be experienced at www.pulselink.net/video.

9. PULSE~LINK's "CWave" technology enables HD content to be streamed throughout the home with Internet Protocol Television ("IPTV") functionality and provides End-to-End Quality of Service, while still preserving content protection mechanisms.

10. Tzero is committing false or deceptive advertising by using a pattern of false and misleading statements to not only illicitly further its own market position, but to derail PULSE~LINK's market entry by wrongfully discrediting PULSE~LINK's pioneering developments, demeaning its recognized UWB technology, systematically interfering with PULSE~LINK's standardization efforts, creating confusion in the marketplace to hinder PULSE~LINK's market entry and consolidation, and interfering with PULSE~LINK's business relationships with customers and potential customers.

11. Tzero has repeatedly denigrated PULSE~LINK's established UWB technology and products using false and/or misleading statements and press releases while falsely characterizing its own UWB products as the first, only and highest performing solution in the industry, statements which it knew to be false or misleading.

IV. FACTUAL BACKGROUND

A. *PULSE-LINK is the True Pioneer of Ultra-Wideband Communication Technology over Coaxial Cables, and Not Tzero.*

12. Contrary to what Tzero has been preaching, PULSE~LINK is the leading innovator in UWB communications. Founded in 2000, PULSE~LINK is the oldest UWB company focused on high-speed commercial communications, and is widely recognized as the pioneer of a broad range of UWB technologies.

13. PULSE~LINK was the first semiconductor company to develop UWB technology for what is commonly known as "whole-home distribution" of interactive high-definition

multimedia content over a hybrid wired/wireless network. PULSE~LINK's UWB technology enables HD content to be streamed throughout the home by using existing coaxial cables eliminating the need for tearing up walls and rewiring. The entire home can be networked with wireless connectivity coordinating Set-top Boxes, HDTVs, DVRs, DVD players, Gaming Devices, Media Center PCs, and other multimedia equipment without interference.

14. In 2002—a year before Tzero was even founded—PULSE~LINK was the first to invent and demonstrate UWB over band limited channels such as coaxial cables. PULSE~LINK's Founder & CTO, John Santhoff, was later recognized by EE Times as "Innovator of the Year" for this breakthrough innovation in UWB technology.

15. In October 2003, at the UWB World Conference in San Jose, California, PULSE~LINK first publicly demonstrated its UWB solution wirelessly carrying multiple streams of broadcast quality video across 20 meters at 125 Mega Bits per second ("Mbps").

16. On December 13, 2004, Pulse~LINK announced an astonishing 1.3 giga-bit-per second ("Gbps") performance, which is the equivalent of 1,300 Mbps. In addition, PULSE~LINK publicly demonstrated 667 Mbps of data throughput, presenting Consumer Electronics manufacturers with DVI, HDMI, and 1394b cable replacement opportunities. In concurrent demonstrations, PULSE~LINK achieved multiple HDTV streams through a seven inch concrete wall and a steel frame drywall at 10 meters.

17. In August 2005, PULSE~LINK was the first to announce and demonstrate the industry's fist real-time transmission of UWB using JPEG2000 specifically to enable wireless High-Definition Multimedia Interface ("HDMI") .

18. PULSE~LINK was also the first UWB Company to pursue whole-home High Definition networking using a combination of wired and wireless UWB.

19. In January 2006, at the Consumer Electronics Show ("CES"), PULSE~LINK publicly demonstrated the industry's first UWB data rate of 1.3 Gbps and unveiled the industry's first solution capable of 1394-over-coax cable (called "CWave") in joint demonstrations with the 1394 Trade Association. PULSE~LINK also publicly demonstrated its wireless UWB system using JPEG2000 marking the industry's first real-time, wireless HD gaming experience using an XBox

360 and the industry's first wireless DVI/HDMI equivalent between a PC and High Definition television display.

20. In May 2006, at the Digital Home Conference and at the Parks Connections Conference in Santa Clara, California, PULSE~LINK unveiled and repeatedly demonstrated its unprecedented 1.3 Gbps wireless and coax cable CWave UWB chipset solution. At this convention, PULSE~LINK gave Tzero executives and officers a personal presentation of PULSE~LINK's UWB solution and chipset.

21. Also in May 2006, PULSE~LINK went beyond technology demonstrations and publicly verified the actual application layer data rate of its UWB solution using an independent, third party validation device (known as "Smartbits") accepted throughout the industry. Using the Smartbits device, PULSE~LINK made history verifying a 400 Mbps application layer data rate for UWB over both a wireless and coax network.

22. On July 26, 2006, PULSE~LINK announced the independent validation of its 1394-over-coax solution based on its CWave chipset. The validation report, generated by Quantum Parametrics (the leading provider of 1394 implementation test tools) independently confirmed PULSE~LINK's unprecedented application layer data rated in excess of 400 Mbps—which is the required data rate benchmark for the 1394 Trade Association ("1394-TA") and future 1394-S400 over coax products. Tzero was later invited by the 1394-TA to submit its technology for similar validation, but declined to do so.

23. In October of 2006, PULSE~LINK was the first to demonstrate simultaneous operation of Ethernet and 1394-S400 over coaxial cable. This demonstration was significant because it simultaneously satisfied the requirements of two large trade organizations—the Digital Living Room Network Alliance ("DLNA") and the High Definition Audio Video Network Alliance ("HANA").

24. At the Consumer Electronics Show in 2007, PULSE~LINK demonstrated its Whole Home Interactive HD solution enabling true "room-to-room" networking of HD content for the entire home. PULSE~LINK was awarded an "Innovations Design and Engineering Award" at this conference.

25. In May 2007, PULSE~LINK was again recognized and awarded with the "Red Herring 100 Award" as one of the top 100 private companies driving the future of technology.

26. Recently, on December 4, 2007, Otoscope, an independent testing organization, released its report illustrating PULSE~LINK's data rates to be at least 10 times those of any tested company in the UWB industry and verified PULSE~LINK's throughput data rate at 890 Mbps at the application layer. *See* Exhibit 1. The Otoscope report concludes that PULSE~LINK's "CWave appears to be the clear technical leader in home networking and is well positioned to emerge as the 21st century architecture for full-home multimedia connectivity." *See id.*

B. ***There is No Industry Standard For UWB-Over-Coax or Wireless HDMI Contrary to Tzero's False and Misleading Claims.***

27. Tzero misleadingly claims that there is an established UWB Standard for the UWB-over-coax and wireless HDMI products Tzero offers and that only Tzero complies with this standard (which Tzero often refers to as the WiMedia standard).

28. However, the fact of the matter is there is no standard for UWB-over-coax or wireless HDMI using UWB technology, as Tzero knows full well.

29. Nevertheless, in promoting its UWB-over-coax and wireless HDMI products, Tzero's press releases repeatedly claim that "[u]nlike proprietary offerings, Tzero's platform is based on standards from the WiMedia Alliance and is guaranteed to co-exist with other WiMedia-complaint devices." *See, e.g.,* Exhibit 2 (Tzero Press Release dated December 4, 2006).

30. Tzero has, and continues to, make such misleading claims to the industry and customers that its products comply with this non-existent UWB Standard. For example, in a December 7, 2006 presentation to an important trade organization (HANA), Tzero claimed that it was working on a "demo of HANA multi-room connectivity using 1394 over (WiMedia standard) UWB over coax." *See* Exhibit 3, at p.2.

31. In a April 3, 2007 presentation to another critical UWB trade organization (the 1394-TA), Tzero misleadingly claimed that "WiMedia **is** the industry standard." *See* Exhibit 4, at p.28 (emphasis in original).

32. In a more recent press release dated June 12, 2007, Tzero again misleadingly claimed that "Now, Tzero's ZeroWire chipset gives both CE manufacturers and service providers a standards-based solution that can cover the whole home . . . No other chipset provides this capability." *See* Exhibit 5.

33. In a 2007 "Retailers Guide" publication for Tzero's wireless HDMI product, Tzero claimed to potential customers that "[c]omplaince with Industry standards is mandatory" and that "[c]ompatibility with the ultra wideband standard, as defined by WiMedia Alliance, is a critical purchase criterion" *See* Exhibit 6.

34. By analogy to the introduction of the video recorder, with the above pattern of conduct, Tzero has and continues to deceptively promote itself as the accepted VHS of the industry while disparaging PULSE~LINK as the Betamax technology that the industry has passed or should pass by. Tzero's repeated claims are misleading and false, and are made with the specific intent to harm PULSE~LINK. There is simply no standard for UWB-over-coax or wireless HDMI, and Tzero's claims are therefore misleading and false.

C. *Tzero Unfairly Targets PULSE~LINK With Attacks On Its Technology And "Proprietary" Offerings.*

35. While heralding itself as the one and only industry UWB standard (despite the fact that no standard exists for UWB-over-coax or wireless HDMI), Tzero goes on to misleadingly conjure up baseless fears about PULSE~LINK's so-called non-standard, "proprietary" technology in a concerted effort to drive customers and the industry away from PULSE~LINK and into the hands of Tzero.

36. Using its website, press releases, internet postings, blogs, and industry presentations, Tzero has, and continues to use false or misleading advertising employing scare-tactics that PULSE~LINK's non-WiMedia, "proprietary" solution will interfere with, disable or cause disastrous harm to other products utilized in the home and must be avoided at all costs.

37. Although Tzero's press releases, public statements and internet postings are carefully crafted not to expressly refer to PULSE~LINK by name, Tzero is in fact singling out PULSE~LINK by specifically attacking and mischaracterizing its technology—so-called non-

standard, non-WiMedia technology that can only be understood as PULSE~LINK's. In fact, PULSE~LINK is well known throughout the industry (and to Tzero specifically) as the only non-WiMedia company with commercially viable UWB products at this time, and is therefore the only company with so-called non-WiMedia proprietary offerings, and the obvious target of Tzero's disparagement campaign.

38. Consequently, Tzero's repeated denigration of non-WiMedia proprietary offerings are, and can only be, squarely directed at PULSE~LINK and its products.

39. For instance, on March 8, 2007, Tzero's founder and now CEO, Rajeev Krshnamoorthy, posted a public statement on the Ultra Wideband Blog (hosted on Tzero's website) stirring up fear about the use of non-WiMedia, proprietary UWB products in the entire wireless industry. Specifically, Tzero charged that non-standard UWB products (which can only refer to PULSE~LINK) would "result in interference and chaos and greatly reduce the likelihood of widespread adoption." *See* Exhibit 7, at p.4. Further, Tzero claimed that even the use of one single non-standard UWB product would *interfere with and disable all other wireless devices in the home*, from wireless USB printers to Bluetooth headsets, causing " [e]ach year, retailers [to] receive more than $15 billion in returns because of problems like this." *Id.* Tzero claimed that "[w]ith nearly 300 companies soon to ship WiMedia standard-complaint products . . . you can understand the magnitude of the problem created by even one non-standard product." *Id.*

40. As another example, in the 2007 "Retailers Guide" publication for Tzero's wireless HDMI product, Tzero again singled out PULSE~LINK spreading fear that "[n]on-standard, proprietary products will cause interference, won't work and will drive returns of both the accessories themselves, and of other products that use Certified Wireless USB and Bluetooth 3.0 (also based on the WiMedia standard)." *See* Exhibit 6. Tzero went on to claim that the "tens of millions of WiMedia-complaint solutions being shipped by Intel, AMD and hundreds of other leading manufacturers will suffer from this negative impact, adding to your reverse logistics problem." *Id.* At the same time, Tzero promoted itself as the WiMedia standard-compliant solution that was safe for the UWB industry and that "[c]compliance with industry standards is mandatory."

Heller Ehrman LLP

41. Further, in presentations given at trade shows, technology conferences and before key trade organizations, Tzero again improperly targets and attack PULSE~LINK by misleadingly discrediting and drumming up fear about PULSE~LINK's "proprietary" technology which Tzero states does not comply with the standard—all the while promoting Tzero's technology as the only safe standards-based solution. Since there is no standard for the wireless HDMI or UWB-over-coax, Tzero is knowingly creating confusion in the marketplace to the detriment of PULSE~LINK, and at the very least, delaying PULSE~LINK's market penetration and market acceptance of its products.

D. *Despite Its Knowledge of PULSE~LINK's Pioneering Status and Long Established UWB Solution, Tzero Falsely Claims That It Developed The Industry's First, Only and Highest Performing UWB Solution.*

42. Tzero has and continues to falsely claim that it developed the industry's "first", "only" and "highest performing" UWB solution—notwithstanding the well-known fact that PULSE~LINK had developed the first and still highest performing UWB years earlier.

43. Tzero's repeated claims, made to the detriment of PULSE~LINK, are misleading and false across the board. Tzero's publicized solution is neither the first, the only, nor the highest performing UWB solution over a wired or wireless connection.

44. To the contrary, as described above, PULSE~LINK (not Tzero) publicly demonstrated the industry's first UWB solution in 2003—the year Tzero was initially founded and long before Tzero developed its competing solution.

45. Likewise, it was PULSE~LINK (not Tzero) that delivered the first and still highest performing UWB solution at speeds repeatedly demonstrated up to 1.35 Gbps.

46. To date, PULSE~LINK (not Tzero) offers the truly highest performing UWB solution that has been independently verified.

47. PULSE~LINK's landmark demonstrations of its UWB solution dating back to 2003 have been widely publicized and documented in the industry, and accompanied by numerous public press releases. Tzero is fully aware of PULSE~LINK's UWB solution, public demonstrations and performance/data rate verifications.

48. Indeed, in May 2006 Tzero attended the same Parks Connections Conference and had a display booth near PULSE~LINK's demonstration center. At this convention, Tzero's founder and senior staff members received a personal demonstration of PULSE~LINK's UWB solution delivering High Definition TV signals wirelessly at unmatched speeds of up to 1.35 Gbps (i.e., 1,350 Mbps)—performance Tzero cannot come close to attaining even to this day.

49. Notwithstanding its knowledge to the contrary, Tzero nevertheless continued to falsely claim that it was the first, only and highest performing UWB solution. For instance, in a June 12, 2006 press release (after Tzero received the personal demonstration of PULSE~LINK's solution delivering broadcast-quality video at speeds up to 1.35 Gbps), Tzero still claimed it was introducing, that very day, the "Industry's *first* and *highest performing* solution that delivers broadcast quality video over wireless networks." *See* Exhibit 8 (emphasis added). Indeed, even the title of Tzero's June 12, 2006 press release falsely claimed that "Tzero Unveils the Industry's First Wireless Solution that Delivers Broadcast-Quality Video." *Id.* In addition, Tzero falsely stated that "[t]oday, *only* the Tzero chipset solution has non-line of sight operation, which enables devices to communicate wireless though walls to extend to across multiple rooms." *Id.* (emphasis added).

50. In a November 6, 2006 press release, Tzero again—despite its knowledge to the contrary—falsely claimed that "Tzero is the *only company* now delivering a high bandwidth solution that can easily handle multiple video streams and deliver them throughout a home." Exhibit 9. (emphasis added).

51. On information and belief, Tzero continues to make these knowingly false and misleading claims to this day. For instance, in a February 14, 2007 press release, Tzero again falsely claimed that "Unlike other offerings, Tzero's UWB is the *only* technology that can function wirelessly and over existing home wiring to create a whole home entertainment network." Exhibit 10 (emphasis added). More recently, in a June 12, 2007 press release, Tzero went so far as to claim that its "New ZeroWire Solution Delivers Wired and Wireless Performance *More than 2X Greater than Competing Technologies*." Exhibit 5 (emphasis added). Of course, this is false as Tzero's products are not capable of speeds even close to 1.35 Gbps as PULSE~LINK has repeatedly demonstrated.

52. Accordingly, Tzero's repeated public claims (continuing to this day) that it is the first and only UWB solution are knowingly and unquestionably false. Likewise, Tzero's claims to have the highest performing UWB solution are knowingly false as Tzero's later-in-time ZeroWire chipset cannot operate anywhere near PULSE~LINK's demonstrated data rates of up to 1.35 Gbps at the physical layer, nor PULSE~LINK's publicly tested and verified rate of 890 Mbps at the application layer.

E. *Tzero Has Done Everything In Its Power to Attempt To Block The 1394-TA Standards Body From Adopting a 1394-Over Coax Standard Incorporating PULSE~LINK's UWB Technology.*

53. Since early 2006, PULSE~LINK has worked very closely with the 1394-TA (and other UWB trade associations) to develop a standard for 1394-over-coax using UWB technology.

54. The typical standardization process within the 1394 Trade Association includes: (i) a public call for proposals by outside technology companies; (ii) technical review and approval by a 1394-TA subcommittee of the best proposal; (iii) approval by the general membership; and then (iv) ratification by the Board of Directors.

55. In early 2006, when the 1394-TA called for proposals, PULSE~LINK and Freescale Semiconductor duly submitted their technologies for consideration. Tzero did not.

56. When the 1394-TA subcommittee voted on and approved PULSE~LINK's technology, Freescale Semiconductor withdrew from the 1394 Trade Association and the UWB market altogether. Even then, Tzero remained silent and did not submit its own technology for consideration or object to PULSE~LINK's approved technology for the 1394-TA standard.

57. In January 2007, the 1394-TA general membership approved PULSE~LINK's technology as the basis for the 1394-over-coax standard. Only the final step of ratification by the Board of Directors was needed to establish a 1394-over-coax standard incorporating PULSE~LINK's approved UWB technology.

58. Acting outside the normal standardization process and waiting until the very final stage of ratification, Tzero then intentionally sought to interfere and disrupt the 1394-TA's ratification of a 1394-over-coax standard based on PULSE~LINK's approved UWB technology.

When it was clear that the 1394-TA was in the final stages of ratifying the standard, Tzero interjected and disrupted the final decision by once again peddling its false and misleading claims that non-WiMedia, "proprietary" solutions are dangerous and that Tzero and WiMedia are the standard in UWB. Tzero's efforts were alarmingly successful as the 1394-TA's final stage of ratification has been unusually delayed.

F. ***Tzero has Systematically Targeted and Interfered with PULSE~LINK's Business.***

59. On information and belief, Tzero has made an organized effort to target and interfere with PULSE~LINK's business relationships, including, but not limited to the various UWB trade associations, including the 1394-TA as mentioned above, and other actual and/or potential UWB customers and technology partners.

60. In addition, PULSE~LINK is informed and believes, and thereupon alleges that Tzero has and continues to single out PULSE~LINK, trying to copy its business and product development plans, and interfering with its business relationships by any means necessary. For instance, at a tradeshow for the cable industry in Las Vegas on May 08, 2007, Tzero's recently discharged Chief Executive Office, Mr. Gullet, was caught eavesdropping on PULSE~LINK engineers as they were discussing technical aspects of PULSE~LINK's UWB technology with a potential customer. Mr. Gulett attempted to disguise himself by removing his mandatory identification badge issued by the tradeshow organizers that was required to be worn at all times and faking like he was a disinterested party immersed in a conversation over his cell phone. When PULSE~LINK personnel finally identified Mr. Gulett, he immediately put away his phone and hurried away from PULSE~LINK's booth.

61. Because of Defendants' conduct, PULSE~LINK has lost significant business relationships and opportunities, and Tzero has unjustly enriched their position in the marketplace.

FIRST CAUSE OF ACTION

False Description and Misrepresentation

(Section 43(a) of the Lanham Act, 15 U.S.C. § 1125(a))

62. PULSE~LINK refers to and incorporates paragraphs 1 through 61 inclusive, as though fully set forth herein.

63. Tzero has made false, deceptive and misleading descriptions and misrepresentations regarding the nature, characteristics, qualities and approval of both PULSE~LINK's technology and Tzero's competing technology.

64. Tzero's conduct has caused, and will continue to cause, PULSE~LINK to suffer irreparable injury to its business, reputation and goodwill in the UWB industry for which PULSE~LINK has no adequate remedy at law. On information and belief, unless enjoined by Court, Tzero will continue to make false, misleading and deceptive claims about PULSE~LINK, its products, and Tzero's own products.

65. Accordingly, PULSE~LINK is entitled to a preliminary and permanent injunction prohibiting Tzero from making further false, misleading and deceptive descriptions and misrepresentations.

66. PULSE~LINK is also entitled to recover Tzero's profit, any and all damages sustained by PULSE~LINK, corrective advertising and costs of the action pursuant to 15 U.S.C. § 1117.

SECOND CAUSE OF ACTION

Unfair Competition and Deceptive Trade Practices

(Cal. Bus & Prof. Code §§ 17200 *et seq.*)

67. PULSE~LINK refers to and incorporates paragraphs 1 through 66 inclusive, as though fully set forth herein.

68. Tzero's unlawful, unfair, deceptive, and misleading conduct, described above, separately and in combination constitute unfair competition in violation of California Business and Professions Code §§ 17200 *et seq.* Such conduct includes, but is not limited to: Tzero's public smear campaign against PULSE~LINK and non-WiMedia, "proprietary" solutions; Tzero's false, misleading and deceptive claims that it is the first, only and highest performing UWB solution; Tzero's false, misleading and deceptive claims that it is the only standard-based solution; Tzero's concerted effort to block PULSE~LINK's UWB technology from being adopted as an application standard by the 1394-TA; and Tzero's effort to copy, interfere with and disrupt PULSE~LINK's business plans and business relationships.

69. PULSE~LINK is informed and believes, and thereupon alleges that Tzero's actions were specifically designed to gain unfair advantage in the industry and undermine PULSE~LINK.

70. As a direct result of Tzero's actions, PULSE~LINK's business and goodwill have been irreparably damaged.

71. PULSE~LINK is informed and believes and thereupon alleges that unless Tzero's ongoing conduct is enjoined by the Court, Tzero will continue their unfair business practices causing irreparable harm to PULSE~LINK for which there is no adequate legal remedy.

THIRD CAUSE OF ACTION

Intentional Interference With Prospective Economic Relations

72. PULSE~LINK refers to and incorporates paragraphs 1 through 71 inclusive, as though fully set forth herein.

73. PULSE~LINK has developed economic relationships with existing and potential UWB trade associations, customers, and technology developers likely to produce future economic benefit and economic advantage.

74. For instance, PULSE~LINK had and continues to have an economic relationship with the 1394-TA (as well as other UWB trade associations) to establish an UWB-over-coax standard based on PULSE~LINK's approved UWB technology that, once adopted, would yield significant future economic benefit to PULSE~LINK.

75. Tzero as direct competitor and member of the 1394-TA (as well as the other key UWB trade associations that PULSE~LINK participates in), knew of the existence of PULSE~LINK's relationships with the 1394-TA, its member companies, as well as other trade associations, potential customers and technology developers.

76. Tzero engaged and continues to engage in wrongful conduct, as described above, designed to interfere with and/or disrupt PULSE~LINK's economically advantageous relationships by repeatedly targeting and discrediting PULSE~LINK in the marketplace. Tzero repeatedly attacked PULSE~LINK and "proprietary" solutions as disastrous for the entire market which is compounded by Tzero's false and deceptive claims to be the first, only and highest performing UWB solution as well as the only safe, standards-based solution (when no UWB standard exists).

Further, Tzero targeted PULSE~LINK trying to block the 1394-TA from adopting a UWB standard based on PULSE~LINK's technology.

77. Tzero intentionally engaged in this pattern of wrongful conduct designed to disrupt PULSE~LINK's business relationships and for the purpose of disrupting these relationships to procure similar or identical relationships for itself in the UWB market.

78. PULSE~LINK's economic relationships with 1394-TA (its member companies, as well as other trade associations, potential customers and technology developers) were actually interfered with and/or disrupted.

79. As a direct and proximate result of Tzero's wrongful acts, PULSE~LINK has been damaged in an amount to be determined at trial.

80. Tzero's actions were oppressive, fraudulent, and/or malicious, and on those grounds PULSE~LINK seeks an award of punitive damages sufficient to punish and deter such conduct.

81. Additionally, PULSE~LINK has no adequate remedy at law for the damages threatened to be suffered in the future if Tzero is permitted to continue to interfere with PULSE~LINK's prospective economic advantage as described above. Indeed, PULSE~LINK would suffer great and irreparable injury and monetary damages may be very difficult to quantify. Therefore, PULSE~LINK is also entitled to injunctive relief, including a preliminary injunction, prohibiting further interference with PULSE~LINK's prospective economic advantage with potential customers, developers, and trade associations working to establish a standard for UWB applications.

FORTH CAUSE OF ACTION

Negligent Interference With Prospective Economic Relations

82. PULSE~LINK refers to and incorporates paragraphs 1 through 81 inclusive, as though fully set forth herein.

83. PULSE~LINK has developed economic relationships with existing and potential UWB trade associations, customers, and technology developers likely to produce future economic benefit.

84. For instance, PULSE~LINK had and continues to have an economic relationship with the 1394-TA (as well as other UWB trade associations) to establish an UWB-over-coax standard based on PULSE~LINK's approved UWB technology that, once adopted, would yield significant future economic benefit to PULSE~LINK.

85. Tzero as a direct competitors and member of the 1394-TA (as well as the other key UWB trade associations that PULSE~LINK participates in), knew of the existence of PULSE~LINK's relationships with the 1394-TA (its member companies, as well as other trade associations, potential customers and technology developers).

86. Tzero engaged in wrongful conduct, described in detail above, including but not limited to attacking PULSE~LINK and "proprietary" solutions as dangerous for the entire market, repeatedly issuing false claims to be the first, only and highest performing UWB solution, repeatedly issuing false and/or deceptive claims that Tzero was the only standard-based solution safe for the industry (when no UWB standard exists), and attempting to block the 1394-TA adoption of PULSE~LINK's technology for its standard.

87. It was reasonably foreseeable that Tzero's wrongful conduct would interfere with and/or disrupt PULSE~LINK's economic relationships if Tzero failed to exercise due care. Moreover, Tzero was aware or should have been aware that if it did not act with due care, its actions would interfere with and/or disrupt PULSE~LINK's known economic relationships.

88. Tzero acted negligently in its wrongful conduct and failed to exercise due care that it owed to PULSE~LINK.

89. PULSE~LINK's economic relationships with the 1394-TA (its member companies, as well as other trade associations, potential customers and technology developers) was actually interfered with and/or disrupted.

90. As a direct and proximate result of Tzero's wrongful acts, PULSE~LINK has been damaged in an amount to be determined at trial.

91. Additionally, PULSE~LINK has no adequate remedy at law for the damages threatened to be suffered in the future if Tzero is permitted to continue to interfere with PULSE~LINK's prospective economic advantage as described above. Indeed, PULSE~LINK

would suffer great and irreparable injury and monetary damages which may be very difficult to quantify. Therefore, PULSE~LINK is also entitled to injunctive relief, including a preliminary injunction, prohibiting further interference with PULSE~LINK's prospective economic advantage with potential customers, developers and trade associations working to establish a standard for UWB applications.

FIFTH CAUSE OF ACTION

False and Misleading Advertising

(Cal. Bus & Prof. Code §§ 17500 *et seq.* and common law)

92. PULSE~LINK refers to and incorporates paragraphs 1 through 91 inclusive, as though fully set forth herein.

93. Defendant's acts violate California Business and Professions Code § 17500, *et seq.*, specifically §§ 17500 and 17535, and the common law.

94. Defendants have engaged in false advertising by the acts alleged herein, including but not limited to: its false, misleading and deceptive claims attacking PULSE~LINK and non-WiMedia "proprietary" solutions; its false, misleading and deceptive claims that Tzero offers the first, only and highest performing UWB solution; and its false, misleading and deceptive claims that there is an adopted UWB standard that Tzero complies with.

95. Tzero's conduct has caused, and will continue to cause PULSE~LINK to suffer irreparable injury to its business, reputation and goodwill in the industry for which PULSE~LINK has no adequate remedy at law. PULSE~LINK is informed and believes and thereupon alleges that unless enjoined by the Court, Tzero will continue to make false, misleading and deceptive claims about PULSE~LINK, its products, and Tzero's competing products.

96. Accordingly, PULSE~LINK is entitled to a preliminary and permanent injunction prohibiting Tzero from making further false, misleading and deceptive claims.

97. By its false, misleading and deceptive claims, Tzero has been unjustly enriched at PULSE~LINK's expense. PULSE~LINK therefore respectfully requests restitution to deter future violations and/or to foreclose Defendant's retention of ill-gotten gains.

SIXTH CAUSE OF ACTION

Common Law Unfair Competition

98. PULSE~LINK refers to and incorporates paragraphs 1 through 97 inclusive, as though fully set forth herein.

99. Tzero has made false and misleading explicit and implicit misrepresentations in California to customers and potential customers and engaged in other unlawful and unfair business practices as describe in detail above.

100. On information and belief, Tzero's selective and misleading representations and omission of relevant facts, are likely to cause confusion, mistake or deception concerning the nature, characteristics, and qualities of their products in comparison, connection, or association with PULSE~LINK's products.

101. On information and belief, Tzero knew or reasonably should have known that its marketing programs encourage the sale and substitution of its products and are likely to confuse and/or deceive customers and potential customers, about the nature, characteristics, and qualities of their products in comparison, connection and association with PULSE~LINK or its products.

102. On information and belief, Tzero has caused and unless enjoined by this Court, will continue to cause such confusion.

103. PULSE~LINK is informed and believe, and on that basis alleges that Tzero's actions have been willful and have been undertaken with the purpose of intentionally deceiving the public about its products in comparison, connection, or association with PULSE~LINK or its products.

104. As an actual and proximate result of Tzero's willful and intentional actions, PULSE~LINK has suffered and, unless enjoined by this Court, will continue to suffer injury and damages to their business, reputation, and goodwill.

SEVENTH CAUSE OF ACTION

Unjust Enrichment/Restitution

105. PULSE~LINK refers to and incorporates paragraphs 1 through 104 inclusive, as though fully set forth herein.

106. Tzero has benefited, directly or indirectly, in each and all of the acts alleged herein, and have benefited, directly or indirectly, from the retention, use, investment, and reinvestment of the benefits thereof. As a result, Tzero has been unjustly enriched to their benefit and to the detriment of PULSE~LINK in an amount to be proven at trial. Tzero continues to unjustly receive and retain these benefits at the expense of PULSE~LINK. It would be unjust for Tzero to retain any value they obtained as a result of their wrongful conduct.

107. Accordingly, PULSE~LINK is entitled to full restitution of all amounts in which Tzero has been unjustly enriched at PULSE~LINK's expense. Moreover, Tzero has a duty to account for and make restitution to PULSE~LINK for all monies, property, assets, and all other benefits received or to be received, directly or indirectly, by Tzero as a result of the retention, use, investment and reinvestment thereof.

PRAYER

WHEREFORE, PULSE~LINK prays for judgment against Tzero as follows:

1. A judgment that Tzero has violated Section 43(a) of the Lanham Act by its false, deceptive and misleading product descriptions and misrepresentations.

2. A preliminary and permanent injunction prohibiting Tzero, its officers, agents, servants, employees, attorneys, all parent and subsidiary corporations, all assignees and successors in interest, and all persons or entities acting in concert with Tzero, from continuing to engage in false, deceptive and misleading product descriptions and misrepresentations.

3. An award to PULSE~LINK of Tzero's profit, any and all damages sustained by PULSE~LINK, and costs of the action pursuant to 15 U.S.C. § 1117.

4. A judgment that Tzero has engaged in unfair competition and deceptive business practices in violation of Cal. Bus & Prof. Code §§ 17200 *et seq.*

5. A preliminary and permanent injunction prohibiting Tzero and its officers, agents, servants, employees, attorneys, all parent and subsidiary corporations, all assignees and successors in interest, and all persons or entities acting in concert with Tzero from continuing to engage in further acts of unfair competition and deceptive trade practices.

6. A judgment that Tzero has intentionally interfered with PULSE~LINK's prospective economic advantage.

7. A preliminary and permanent injunction prohibiting Tzero, its officers, agents, servants, employees, attorneys, all parent and subsidiary corporations, all assignees and successors in interest, and all persons or entities acting in concert with Tzero from continuing to commit unfair competition including interfering with PULSE~LINK's prospective economic advantage, business relationships and efforts to establish a standard for UWB communication with trade associations;

8. An award of punitive damages for Tzero's intentional, oppressive, fraudulent, and/or malicious interference with PULSE~LINK's prospective economic advantage.

9. A judgment that Tzero has negligently interfered with PULSE~LINK's prospective economic advantage.

10. A preliminary and permanent injunction prohibiting Tzero, its officers, agents, servants, employees, attorneys, all parent and subsidiary corporations, all assignees and successors in interest, and all persons or entities acting in concert with Tzero from continuing to negligently interfere with PULSE~LINK's prospective economic advantage, business relationships and efforts to establish a standard for UWB communication with trade associations;

11. A judgment that Tzero has engaged in false and deceptive advertising in violation of California Business and Professions Code § 17500, *et seq.* and the common law.

12. A preliminary and permanent injunction prohibiting Tzero its officers, agents, servants, employees, attorneys, all parent and subsidiary corporations, all assignees and successors in interest, and all persons or entities acting in concert with Tzero from continuing to engage in false and deceptive advertising.

13. A judgment that Tzero has engaged in unfair competition and deceptive business practices in violation of the common law.

14. A preliminary and permanent injunction prohibiting Tzero, its officers, agents, servants, employees, attorneys, all parent and subsidiary corporations, all assignees and successors in interest, and all persons or entities acting in concert with Tzero from continuing to engage in further acts of unfair competition and deceptive trade practices in violation of the common law.

15. An award of damages in an amount to be proven at trial for Tzero's false and deceptive advertising, unfair competition, deceptive business practices, and intentional and negligent interference with PULSE~LINK's prospective economic advantage.

16. An order requiring Tzero to account for and make restitution to PULSE~LINK of the ill-gotten gains Tzero unjustly received by its wrongful conduct.

17. An award directing Tzero to pay punitive damages as may be permitted by law.

18. An award directing Tzero to pay corrective advertising or the equivalent in damages to correct the false perceptions in the market created by the wrongful acts of Tzero.

19. For a judgment and order directing Tzero to pay costs of suit and reasonable attorneys' fees; and

20. Such other or further legal or equitable relief that the Court deems just and proper.

DEMAND FOR JURY TRIAL

PULSE~LINK hereby demands a trial by jury on all issues so triable.

DATED: December 21, 2007

HELLER EHRMAN LLP

By: ____________________
John Benassi
Attorneys For Plaintiff
PULSE~LINK INCORPORATED

SD 894311 v1

Exhibit 1

octoScope

UWB Test Report

By

Fanny Mlinarsky and John Ziegler

December 4, 2007

UWB Test Report 1
Background 2
UWB Applications 3
UWB Video Distribution 4
UWB Technology 5
Test Methodology 9
Test Results 10
Analysis of Results 17
Conclusion 18

octoScope

With the recent media attention on UWB and the announcements of 22 UWB based Wireless-USB (W-USB) products being certified by the WiMedia Alliance, the time has come to evaluate this exciting new wireless technology and see if it has delivered on the promise of transporting hundreds of megabits per second while delivering superior QoS.

This test was organized under the aegis of EE Times and our plan was to have a group of UWB companies collectively sponsor the test to promote their recently announced UWB products. UWB silicon providers and system vendors were invited to participate or to co-sponsor the test. Based on the wave of recent WiMedia certifications, we anticipated that the latest and greatest WiMedia reference designs would be submitted for the test. However, none of the WiMedia vendors chose to participate and we had to use off-the-shelf commercially available WiMedia W-USB products. The only sponsor and willing participant in the test was UWB silicon provider Pulse-LINK.

The Pulse-LINK CWave implementation focuses on video distribution and embodies the complete point-to-point and point-to-multipoint communication system with TCP/IP throughput of over 500 Mbps and reaching 890 Mbps at close range (figure 15). By comparison, the top throughput measured over the WiMedia links was an order of magnitude lower – around 50 Mbps at close range.

Background

The initial public awareness of Ultra Wide Band (UWB) came about in February 2002 when the FCC allocated 7.5 GHz of spectrum – 3.1 to 10.6 GHz – for use by UWB devices, enabling this previously classified military technology to be commercialized, as had happened with CDMA years before.

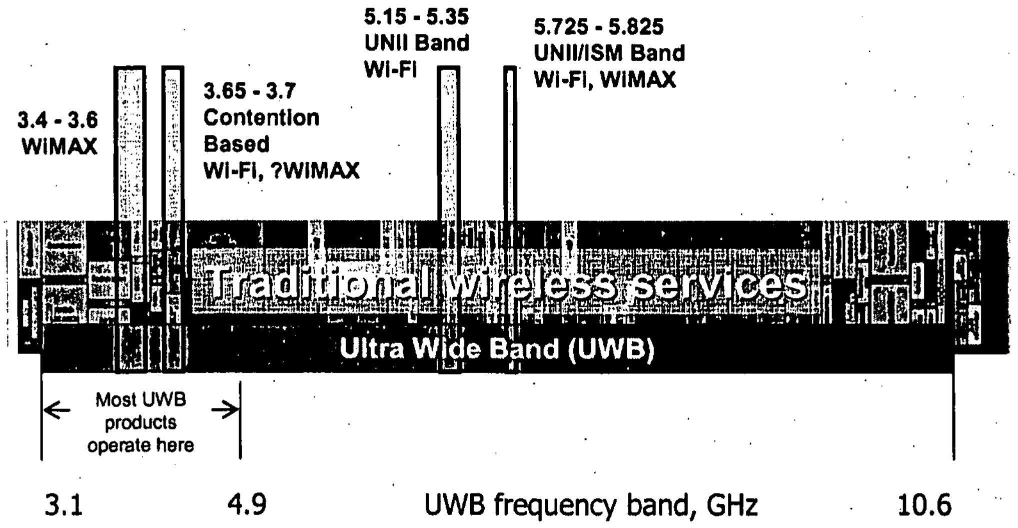


Figure 1: *UWB operates in the noise floor of traditional wireless applications and is able to share the already allocated spectrum with other services while only negligibly raising their noise floor*

The unique benefit of UWB signaling – its ability to operate at the noise floor – enables UWB devices to peacefully co-exist and share spectrum with traditional wireless services (figure 1). The low transmit power authorized by the FCC (table 1) curtailed the range of

UWB links to about 10 meters limiting this technology to Wireless Personal Area Networking (WPAN) applications. This range is not a fundamental limitation of UWB technology itself. If transmit power limits were increased the range of UWB would increase as well.

Table 1: *Indoor UWB emission limits in the US*

Frequency range (GHz)	Average EIRP* (dBm/MHz)	Mode
3.1-10.6	-41.3	Intentional
1.99-3.1	-51.3	Unintentional
1.61-1.99	-53.3	Unintentional
0.96-1.61	-76.3	Unintentional
<0.96	See Part 15.209	Unintentional

* *Effective Isotropic Radiated Power*

The FCC approved the UWB spectrum allocation and transmit power limit, but did not specify an air interface, modulation or Media Access Controller (MAC) – specifications that were undertaken by the IEEE 802.15 committee in December of 2002 and abandoned in January of 2006 (see reference [2]). Today, UWB implementations are not constrained to any particular MAC or PHY and have the flexibility of using any MAC and PHY layers as long as they comply with the FCC spectrum mask limits.

Many of the companies originally working on the IEEE 802.15 standard joined the WiMedia Alliance creating their own specification of UWB based on OFDM PHY and a distributed USB-like MAC. This WiMedia specification was published as the European Computer Manufacturers Association ECMA-368 standard. Pulse-LINK developed and enhanced their original impulse-based UWB signaling and implemented their solution based on the IEEE 802.15.3b MAC.

UWB Applications

While the original goal of 802.15.3 was wireless video distribution with QoS, the WiMedia Alliance has chosen to focus primarily on the PC-centric W-USB application.

Pulse-LINK, an early pioneer of UWB technology, focused on the original Consumer Electronics (CE) application of UWB – HD video distribution. Pulse-Link's approach has an interesting twist in that they have developed their CWave architecture to work on both wireless and wired media such as coax, power-line and phone-line.

An innovative aspect of the CWave architecture is that any device using the Pulse-Link chipset is capable of supporting wireless, coaxial and power-line transmissions under a single 802.15.3b MAC, enabling HD video transport throughout the entire house on whatever media are available. The isochronous 802.15.3b MAC, with QoS built-in from the ground up, is designed to support whole-home networking of streaming video, multi-channel audio and high data rate networking.

Comparing PC-centric WiMedia products with CE-centric Pulse-LINK products may at first seem inappropriate, but with the rapid convergence of PC and CE devices the mission of both solutions is to move bits fast and with QoS that supports high quality video, audio and data. It is the speed and quality of UWB transport that we set out to test.

UWB Video Distribution

While Pulse-LINK persisted with the initial goal of 802.15.3 – streaming and distribution of HD content and multi-channel audio – the WiMedia group has at least initially strayed from this goal. Only two WiMedia vendors, Tzero and Sigma Designs, announced HD video distribution architectures. And while both companies have announced availability of UWB silicon as far back as CES 2005, neither of them have commercially available products in the market and chose not to submit their reference designs for our test.

Our understanding is that WiMedia may embrace the video applications in the near future, but today most of the commercial WiMedia products are implementations of W-USB. One exception is the Toshiba port replicator that supports USB, Gigabit Ethernet and a video/audio link over a single UWB link, WiDV ™, which is based on the WiMedia compatible air interface.

Video distribution – throughput and network architecture considerations

Video content is transported and stored in a compressed format. Most broadcast and cable TV transmissions and conventional DVDs use MPEG-2 compression. H.264/MPEG-4 and JPEG 2000 are the emerging video compression formats that roughly double the efficiency of video transport and storage afforded by MPEG-2.

Table 3: *Throughput requirements for common video formats and resolutions*

Format		Average throughput required for high quality video	
		480i60	1080p30
Broadcast Cable TV	MPEG-2	8 Mbps	20 Mbps
Windows Media Video DivX XviD QuickTime	MPEG-4 Part 10/H.264	5 Mbps	12 Mbps

The video transport media in a typical home include coaxial, twisted pair, powerline and wireless. Wired video transmission technologies, such as HomePlug™ and HomePNA™ operate within a spectral mask below 30 MHz in order to meet the FCC emissions limit. Pulse-LINK pioneered the use of UWB over these wired media. The wide frequency band of UWB enables CWave to outperform HomePlug and HomePNA on their native media.

Further advantage of the multi-interface CWave architecture is that a single device can simultaneously support multiple media, including powerline now supported by HomePlug and coax and twisted pair now supported by HomePNA. CWave's TDMA

MAC can effectively bridge these disparate media by time-slicing the traffic over multiple network interfaces.

UWB Technology

Today there are two predominant UWB solutions – WiMedia and CWave. The challenge for both technologies is to maximize the dynamic range of the link while still meeting the very low FCC transmit power threshold. Due to the wide spectrum of UWB, frequency-dependent tilt (figure 2) severely compromises the dynamic range of the link. Since RF attenuation increases with frequency, the wider the frequency band the more tilted the receive spectrum and the more dynamic range is lost to receive equalization or transmit pre-distortion.

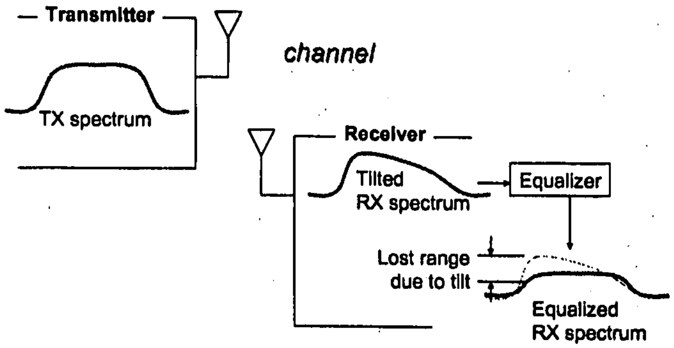


Figure 2: *Channel tilt – the wider the channel the greater the attenuation tilt between high and low frequencies in the channel. To correct the tilt distortion, equalization can be performed in the receiver or reverse tilt pre-distortion can be done in the transmitter.*

WiMedia

The WiMedia specification broke up the available UWB spectrum into 5 Band Groups that are further subdivided into 528 MHz sub-bands (figure 3). Data transmissions can be frequency hopped among the three sub-bands to reduce the average transmit power while maximizing the instantaneous power of symbol transmissions. For example, the OFDM signal can be pulsed in the time domain over any of the 3 frequency sub-bands with one third duty cycle, thereby reducing the average transmit power by a factor of 3 or 4.77 dB. The WiMedia techniques for spreading the power include what WiMedia calls Time-Frequency Interleaving (TFI) and Fixed Frequency Interleaving (FFI). TFI is essentially a technique of frequency hopping the 528 MHz wide OFDM pulses over three bands. The FCC relaxed the -41.3 dBm/MHz limit to -36.5 dBm/MHz for peak power in the 528 MHz sub-bands since the 1/3 duty cycle averages to -41.3 dBm/MHz.

To avoid the UNII band 5.8 GHz interference from Wi-Fi, the current generation of WiMedia products operate in Band Group 1.

WiMedia uses MB-OFDM with data rates of 53.3, 80, 106.7, 160, 200, 320, 400 and 480 Mbps. QPSK modulation is used for data rates up to 200 Mbps and DCM (dual-carrier modulation) is used for data rates of 320 Mbps and higher. On the TX side a single 4 to 6 bit DAC running at 1 GHz is typically used to generate the 528 MHz TX spectrum and on the RX side two 4-bit, 1 GHz A/D converters (one for "I", the other for "Q" component) are typically required to detect and recover the MB-OFDM sub-carriers. One only has to look at the power consumption for these components alone to see this is not a low power technology and that it has substantial complexity in both the TX and RX sections.

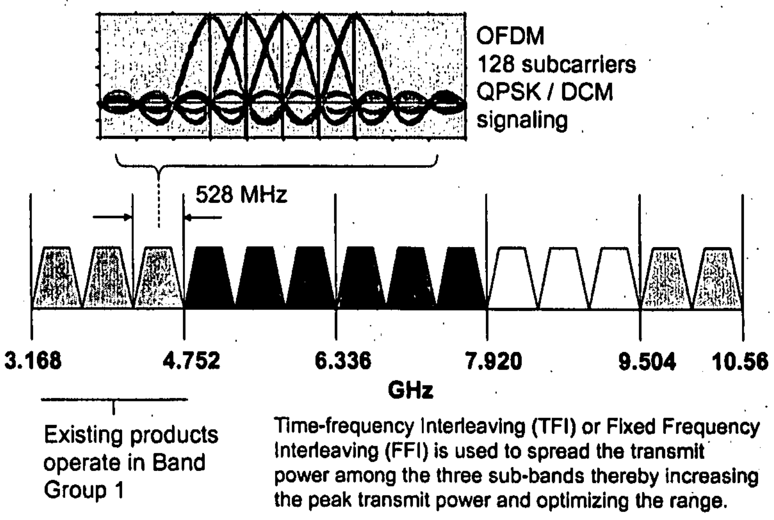

OFDM
128 subcarriers
QPSK / DCM
signaling
528 MHz
3.168
4.752
6.336
7.920
9.504
10.56
GHz
Existing products operate in Band Group 1
Time-frequency Interleaving (TFI) or Fixed Frequency Interleaving (FFI) is used to spread the transmit power among the three sub-bands thereby increasing the peak transmit power and optimizing the range.

Figure 3: *WiMedia MB-OFDM channel assignment in the 3.1 to 10.6 GHz band. Most existing products support Band Group 1. The 528 MHz OFDM sub-bands in each Band Group can be used to interleave the signal and spread its power.*

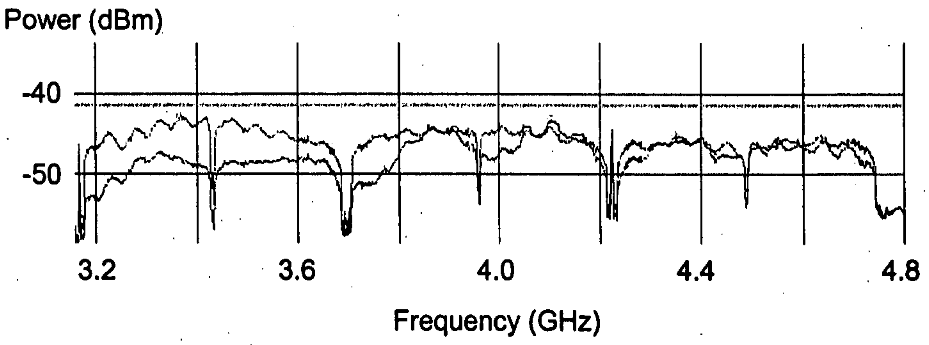

Power (dBm)
-40
-50
3.2
3.6
4.0
4.4
4.8
Frequency (GHz)

Figure 4: *Example of the WiMedia Band Group 1 spectrum showing 3 sub-bands (adapted from an FCC report). For UWB spectrum measurement Agilent has provided E4440A PSA Series Spectrum Analyzer and ETS Lindgren has provided the Model 3117 Double-Ridged Waveguide Horn antenna. Both the analyzer and the antenna cover the entire 3.1 to 10.6 GHz range.*

CWave

Pulse-LINK's CWave signaling scheme uses simple baseband pulses of ~750 ps to spread a bit's total energy over the entire 1.35 GHz of spectrum. WiMedia's more complex architecture uses longer 242 ns pulses requiring the baseband to calculate a 128 point FFT on 528 MHz of spectrum (table 2 of ECMA-368 specification). CWave's considerably simpler architecture may explain why CWave's overall performance appears to be an order of magnitude higher than WiMedia. Pulse-LINK claims much lower power consumption than WiMedia since their implementation avoids the use of power-hungry converters. CWave uses single-carrier BPSK (binary phase shift keying) modulation (figure 5), which requires less stringent equalization than QPSK or DCM and thus can operate more robustly over a wide frequency band.

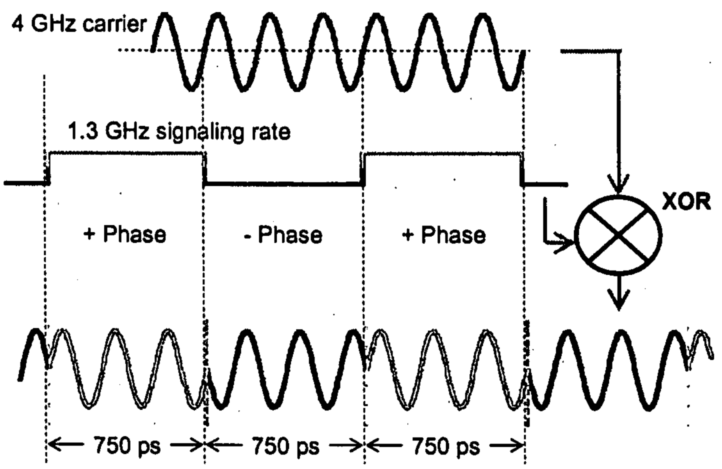

4 GHz carrier
1.3 GHz signaling rate
XOR
+ Phase
- Phase
+ Phase
750 ps
750 ps
750 ps

Figure 5: *CWave modulation scheme – a single carrier BPSK using an XOR gate as the modulator. This example shows a 4 GHz carrier and the modulating waveform of 1.3 GHz. The integer multiple of the carrier cycles per data symbol assists with carrier recovery and enhances the robustness of this scheme.*

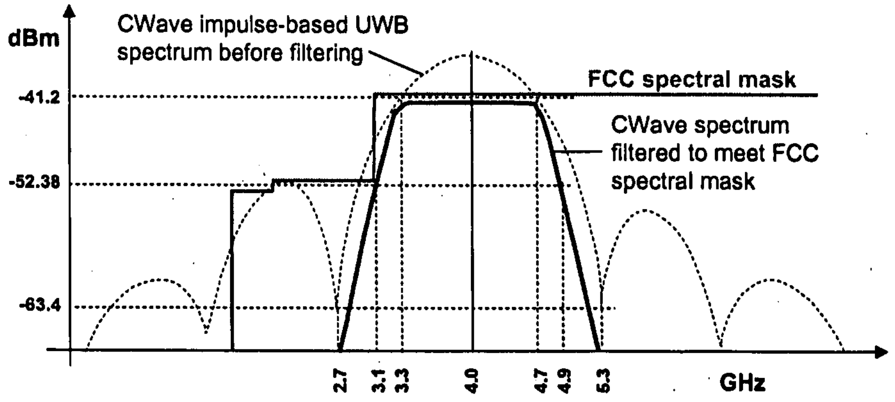

dBm
CWave impulse-based UWB spectrum before filtering
FCC spectral mask
-41.2
CWave spectrum filtered to meet FCC spectral mask
-52.38
-63.4
2.7
3.1
3.3
4.0
4.7
4.9
5.3
GHz

Figure 6: *CWave spectrum. The unfiltered spectrum exhibits the characteristic sin(x)/x shape of an impulse. The filtered CWave spectrum fits well within the FCC limit.*

With a 4 GHz carrier the CWave sin(x)/x shaped spectrum has nulls at 2.7 and 5.3 GHz (figure 6). The CWave spectrum can be moved anywhere within the 3.1 to 10.6 GHz FCC band by changing the carrier frequency. The bandwidth can be expanded or contracted by varying the frequency of the modulating signal (data rate). The current CWave reference design operating band is 3.3 to 4.7 GHz centered around 4 GHz.

CWave implemented a new cutting edge error correction algorithm known as Low-Density Parity Check Coding (LDPC) with FEC rates of ½, and ¾ (table 2). They claim it gives them lower power consumption and a substantial performance improvement over the traditional Reed-Solomon/Viterbi FEC used by WiMedia.

Table 2: *Data rates supported by CWave*

Operation	Transmitted Bit Rate (Mbps)*	FEC Rate	Spreading Factor
1	1350	1	1
2	1013	3/4	1
3	675	1/2	1
4	506	3/4	2
5	338	1/2	2
6	253	3/4	4
7	169	1/2	4
8	127	3/4	8
9	84	1/2	8
10	21	1	64
11	16	3/4	64
12	11	1/2	64

**The CWave reference design uses a 4.05 GHz carrier with the data rate values set to maintain the phase alignment between the carrier and the data signal at the XOR gate as shown in figure 5.*

CWave is capable of 1.35 Gbps of raw data rate. In our tests we were able to demonstrate actual data throughput approaching 900 Mbps at close range.

In addition to the wireless medium, CWave supports transport over 75 ohm coaxial cabling and CATV RF splitters installed in most homes. Pulse-Link claims support at similar data rates for transport over power lines and twisted pair cabling including telephone lines. octoScope did not test performance over power lines or twisted pair, but we look forward to testing these media the near future. Furthermore, CWave's isochronous 802.15.3b MAC and PHY have been down-selected by the membership of the Firewire 1394 Trade Association for extending 1394 functionality over coaxial networks within the home.

Architecturally, CWave appears to offer a significant advantage over the status quo of video transport products requiring disparate MACs to support different media:

- WiMedia UWB or Wi-Fi for wireless
- HomePNA for twisted pair
- MoCA™ (Multimedia over Coax Alliance) or HomePNA for coax
- HomePlug for powerline

It's a compelling idea to have one chip that is capable of supporting all the above media with one common platform:

- One chipset supports wireless, coax, power-line and phone-line
- One common MAC for a uniform QoS across all PHY media types
- MAC supports streaming high quality audio and HD video
- PHY layer bridging is inherent in the TDMA access scheme
- Up to 1 gigabit per second throughput on all PHY media
- Whole home connectivity

The CWave 802.15.3b MAC using its TDMA channel access scheme can time-slice traffic, enabling a single multi-port device to route video and data streams among disparate media in the home. Given the ample throughput of CWave, several simultaneous 1080p streams can be sent around the house time-multiplexed on multiple network interfaces and over multiple media. Thus, a single CWave chipset can replace multiple network chips for transport of digital content wirelessly, over coax, power-line and phone-line.

Pulse-LINK's CWave 802.15.3b MAC was designed from the ground up to support the QoS demands of isochronous streaming of audio, HD video and High Data Rate digital networking across all available PHY transports media within the home.

Test Methodology

This test focused on measuring UWB throughput over wireless and coaxial media. We have uploaded the latest drivers for all the devices under test from the manufacturer's web sites. We used IxChariot for TCP throughput measurements when an Ethernet port was available and the file transfer method (figure 7) when only a USB port was available.

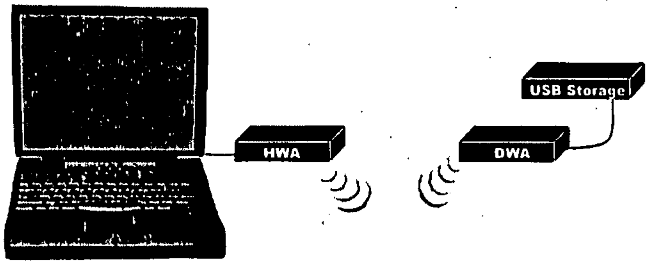


Figure 7: W-USB test configuration
Throughput of W-USB products was measured by timing the file transfer via the W-USB link between the host wireless adapter (HWA) and the device wireless adapter (DWA).

Read and write cycles of a 419 MB file were timed and averaged over several cycles. The fastest WiMedia file transfer we measured lasted 57 seconds. If we assume a 1 second error in registering of the file transfer time, our measurement accuracy is better than +/- 2%. Since we were getting unexpectedly low throughput on the WiMedia devices, we have performed the WiMedia tests at two different houses and verified that the measurements were valid.
Since lower than expected throughput was measured on the WiMedia products, we have repeated the tests on these products at two different houses and our measurements passed the sanity check.

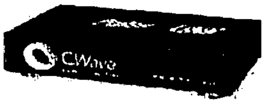
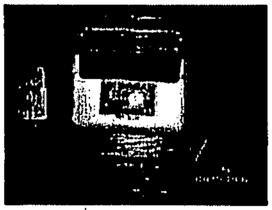
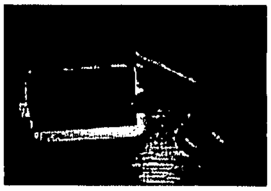
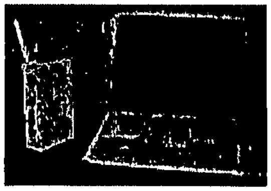
For devices supporting Ethernet – Toshiba port replicator and CWave – IxChariot was used to measure TCP throughput via the Ethernet port (figures 8, 11). We used the filesndl.scr and ultra_high_performance_throughuput.scr Chariot scripts in our testing.

Since the Toshiba port replicator supports both USB and Gigabit Ethernet in addition to the video and audio streams, we tested the throughput of the Toshiba WiMedia link in a couple of ways. First we performed the file transfers over the USB port and then we ran the Chariot TCP throughput test over the Gigabit Ethernet port. We also combined the Chariot test of the Gigabit Ethernet port with the file transfer test on the USB port to measure the combined throughput on the two ports operating together. We have not connected the display while performing the measurements on the data ports since the display drastically limited the range of operation for the WiQuest UWB link.

Test Results

Most of the WiMedia devices in the test were implementations of Wireless USB (W-USB) with the exception of the Toshiba R400 laptop and Pulse-LINK CWave (table 4). Pulse-LINK's CWave was the only UWB device capable of multi-stream HD video transport and the only device supporting coaxial cabling in addition to wireless.

Table 4: *UWB products tested*

Device 1 / HWA	Device 2 / DWA	Chipset	
CWave Wireless PL3100-EVK00 S/N: 0042 Driver: 4.22	CWave Wireless PL3100-EVK00 S/N: 0029	Pulse-LINK	
CWave Coax PL3100-EVK01 S/N: 0033 Driver: 4.22	CWave Coax PL3100-EVK01 S/N: 0017		
IOGEAR Wireless USB Hub GUWH104 S/N: OU78USQ1100377 S/N: OU78USQ1100348 Driver: 1.0-10393	IOGEAR Wireless USB Adapter GUWA100U S/N: OU78USQ1100377 S/N: OU78USQ1100348	Alereon PHY only	
Belkin Wireless USB 2.0 4-Port Hub F5U302-HUB S/N: 15073200479 Ver: 111111 Driver: 1.3.98.1	Belkin Wireless USB 2.0 Dongle FSU302-DNGL S/N: 15073200042 Ver: 111111	WiQuest in the hub	
Belkin Wireless Belkin Cable Free USB 2.0 4-Port Hub F5U301-HUB S/N: 00173F219492 Driver: 1.1.0.0	Belkin Wireless Belkin Cable Free USB 2.0 Dongle FSU301-DNGL S/N: 00173F219492	Wisair	
Y-E Data YD-300D UWB USB 4-Port Hub S/N: 001UWAA1001 Driver: 1.1.0.0	Y-E Data YD-300H UWB USB Host S/N: 001UWAA1002	Wisair	
Toshiba Portege Notebook PC R400-S4933 Part #: PPR40U-00U015 Driver: 3.8.3.7	Toshiba Wireless UWB Port Replicator PA3529U-2PRP S/N: 8272R000193	WiQuest	

W-USB performance

Figure 14 shows the performance of the W-USB products in the test. The throughput of the Belkin FSU302 W-USB link was the highest W-USB throughput measured with around 50 Mbps at close range.

Toshiba R400 performance

Toshiba R400 laptop features a built-in UWB link to its port replicator. This link is based on WiDV™, the WiMedia compatible UWB technology from WiQuest. The port replicator supports Gigabit Ethernet, W-USB, display and audio over a single WiMedia link to the laptop.

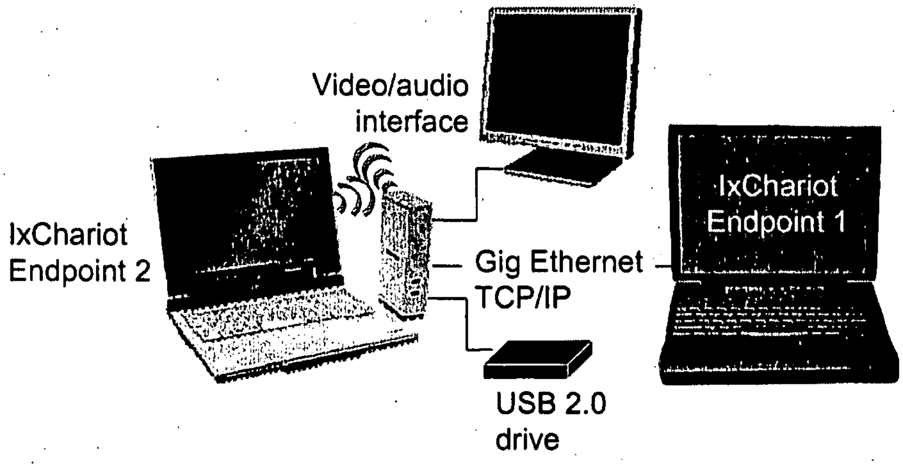


Figure 8: Test setup for measuring throughput of the Toshiba docking station *that interfaces the laptop via a single WiMedia connection to the Gigabit Ethernet port, USB port and video/audio devices*

The Gigabit Ethernet only, the USB only and the combined throughput measurements of the Toshiba port replicator were under 25 Mbps at close range (figures 9, 14, 15).

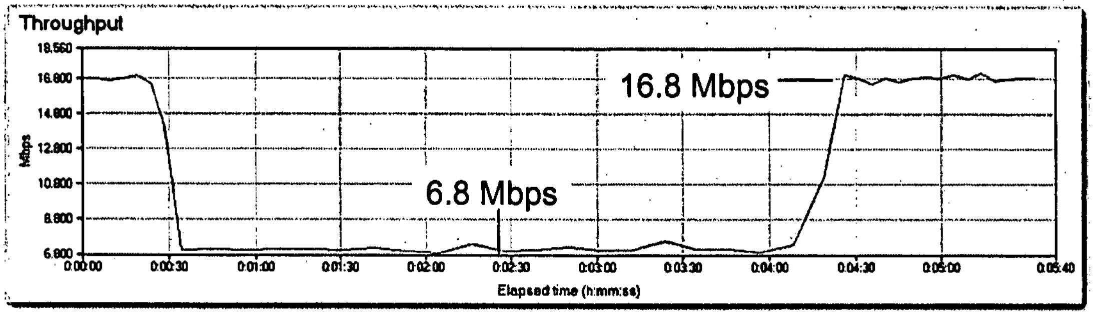


Figure 9: Toshiba throughput *over the WiMedia link between the port replicator and the laptop. This test started with the IxChariot TCP/IP throughput via the Gigabit Ethernet port and then a USB file transfer was initiated over the USB port. The IxChariot plot shows the throughput on the Gigabit Ethernet port dropping from 16.8 Mbps when operating alone to 6.8 Mbps when operating in conjunction with the USB port transferring a file.*

The fact that the throughput of the Gigabit Ethernet port drops during the file transfer on the USB port may mean that Toshiba purposefully manages bandwidth allocation among the Gigabit Ethernet, USB and video/audio interfaces sharing the WiMedia link.

It is difficult to judge how much bandwidth on the WiDV™ interface is allocated to the video stream. At optimum antenna orientations video links were achievable up to distances of 24 to 30 inches, but the quality of the display at this distance was sub-optimum exhibiting a waviness that makes reading the text difficult. The waviness becomes imperceptible at the distance of about 12 inches.

The WiQuest WiDV™ chipset used to implement the Toshiba WiMedia interface uses a proprietary video compression that may be based on the wavelet method, similar to the Analog Devices JPEG 2000. WiQuest claims a factor of 5 video compression reducing the raw SXGA video throughput of 1.8 Gbps (1280 x 1024 x 24 bits x 60 Hz = 1.8 Gbps) down to 377 Mbps. We were unable to verify the actual throughput on the video link. However, the distortion of the image observed at 24 to 30 inches of distance between the port replicator and the laptop was symptomatic of wavelet video compression at a throughput limited to approximately 30 to 40 Mbps. In order to optimize display quality, the Toshiba port replicator documentation specifies a distance limit of 0.5m (19.7").

CWave performance

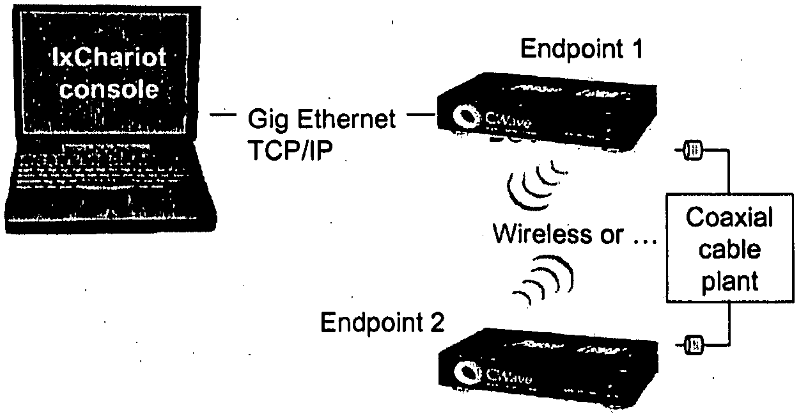
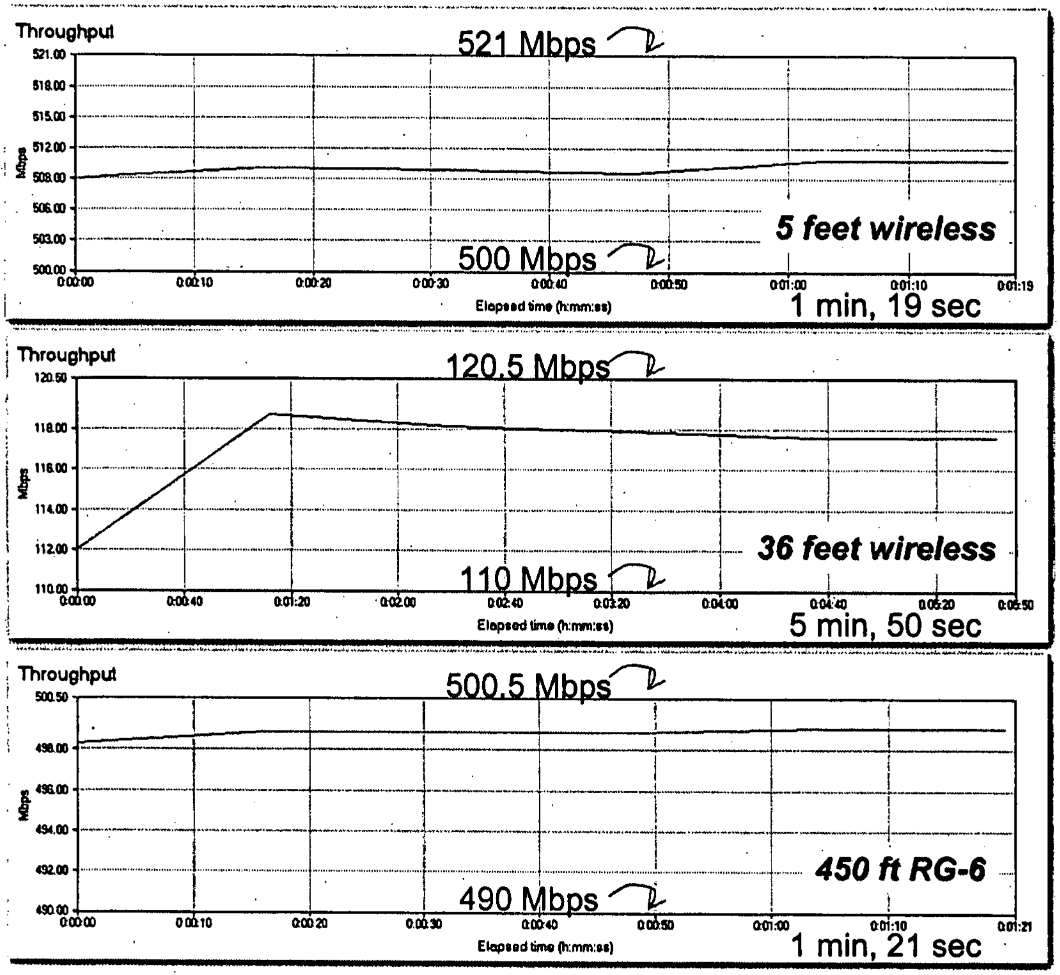


Figure 10: CWave test setup *for measuring TCP/IP throughput with the IxChariot*

CWave throughput measurements were performed using IxChariot (figure 10) over wireless and coaxial media. As a sanity check, we also measured the throughput using iPerf with similar results. The coaxial cabling included some common configurations of the typical RG-59 installations with one or two splitters and also using the high grade RG-6 coaxial cabling to show the supportable range of HD video transmission in the home, which in our test exceeded 525 feet of cabling (table 5).

Although higher transmit power could have been used over RG-6 without violating the FCC emissions limits, we have not adjusted the power and thus have not exercised the coaxial cable length supportable by CWave to its full extent.



Throughput
521 Mbps
500 Mbps
5 feet wireless
Elapsed time (h:mm:ss)
1 min, 19 sec
Throughput
120.5 Mbps
110 Mbps
36 feet wireless
Elapsed time (h:mm:ss)
5 min, 50 sec
Throughput
500.5 Mbps
490 Mbps
450 ft RG-6
Elapsed time (h:mm:ss)
1 min, 21 sec

Figure 11: *IxChariot plots of CWave performance over wireless and coaxial media*

The CWave throughput held at around 500 Mbps at up to 8 feet of wireless range and over much of the coaxial range (figures 11, 13 and table 5). The CWave throughput dropped off to about 115 Mbps at the wireless distance of 13 feet and this throughput was maintained up to 40 feet, at which point we ran out of space in the test facility. We were able to measure 890 Mbps of throughput at a distance of 1 foot using the Pulse-LINK throughput test that give us results similar to IxChariot. However, the Pulse-LINK TCP/IP interface was unable to operate at this data rate. It is our understanding that Pulse-LINK is still optimizing the data rate adaptation algorithm and that the throughput vs. distance performance is expected to improve.

octoScope

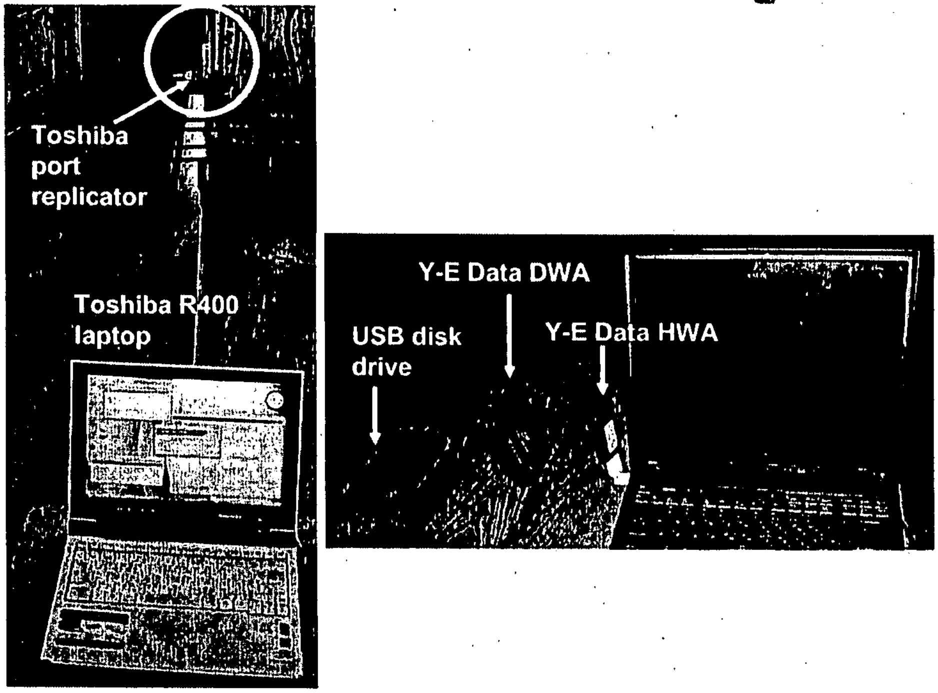

Toshiba
port
replicator
Toshiba R400
laptop
Y-E Data DWA
USB disk
drive
Y-E Data HWA

Figure 12: Photos of test setups – *left: Toshiba laptop and its port replicator; right: Y-E Data W-USB test setup with the USB drive used to copy the file. The Toshiba port replicator data ports were tested without the display connected since the display drastically limited the range of operation.*

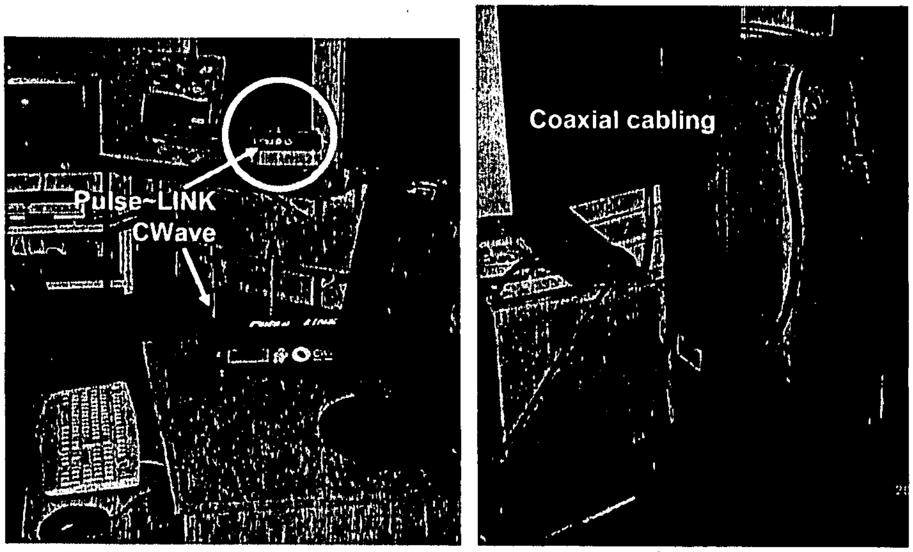

Pulse~LINK
CWave
Coaxial cabling

Figure 13: Pulse-LINK test setup *Left: CWave wireless modules; right: coaxial cable plant with segments of cable packed into boxes and interconnected with external splitters.*

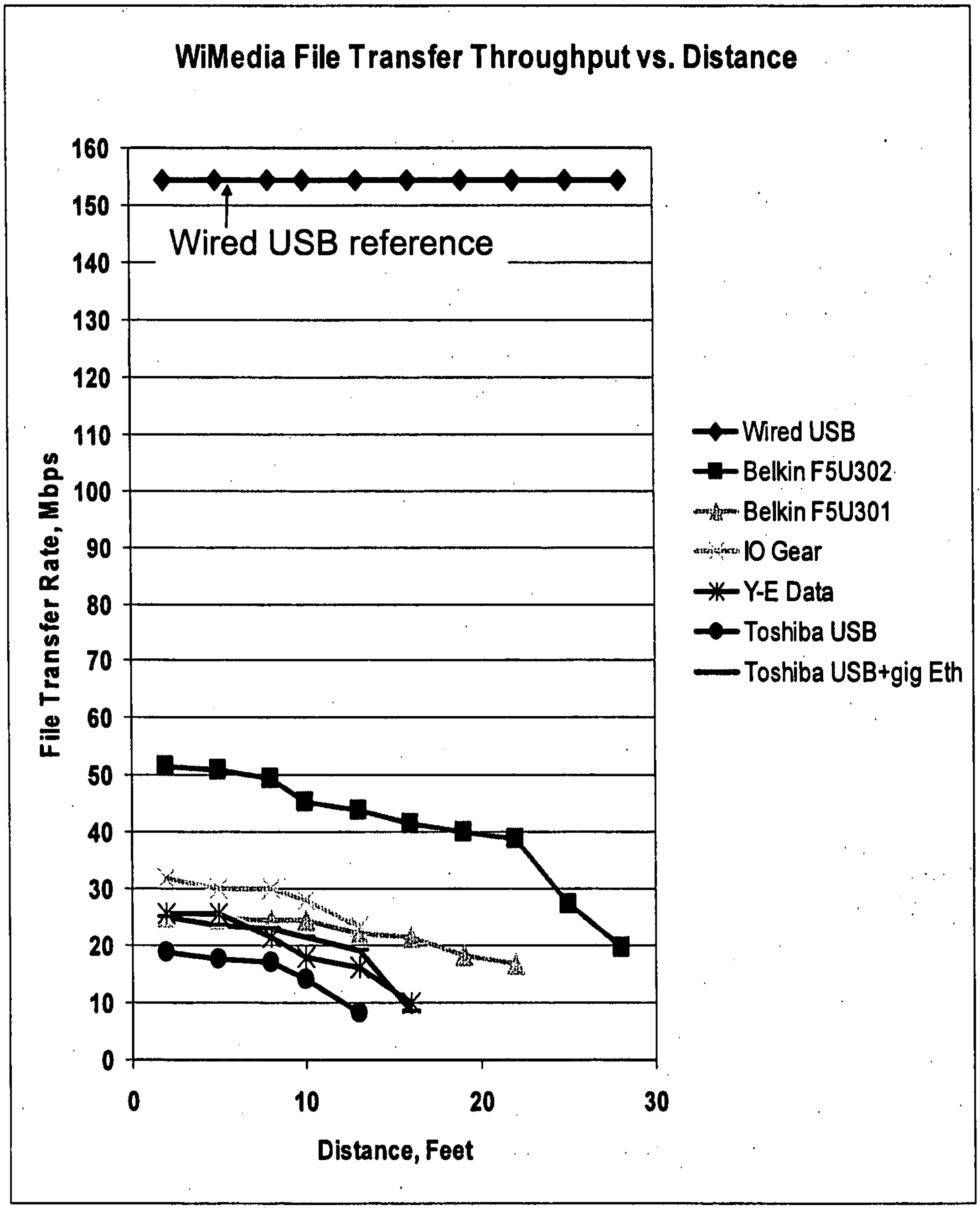

WiMedia File Transfer Throughput vs. Distance
Wired USB reference
File Transfer Rate, Mbps
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
Distance, Feet
Wired USB
Belkin F5U302
Belkin F5U301
IO Gear
Y-E Data
Toshiba USB
Toshiba USB+gig Eth

Figure 14: *WiMedia file transfer throughput vs. distance with the wired USB throughput reference. The values are average of file read and write transfers. The 'Toshiba USB+gig Eth' plot shows the combined throughput of the Gigabit Ethernet port and the USB file transfer.*

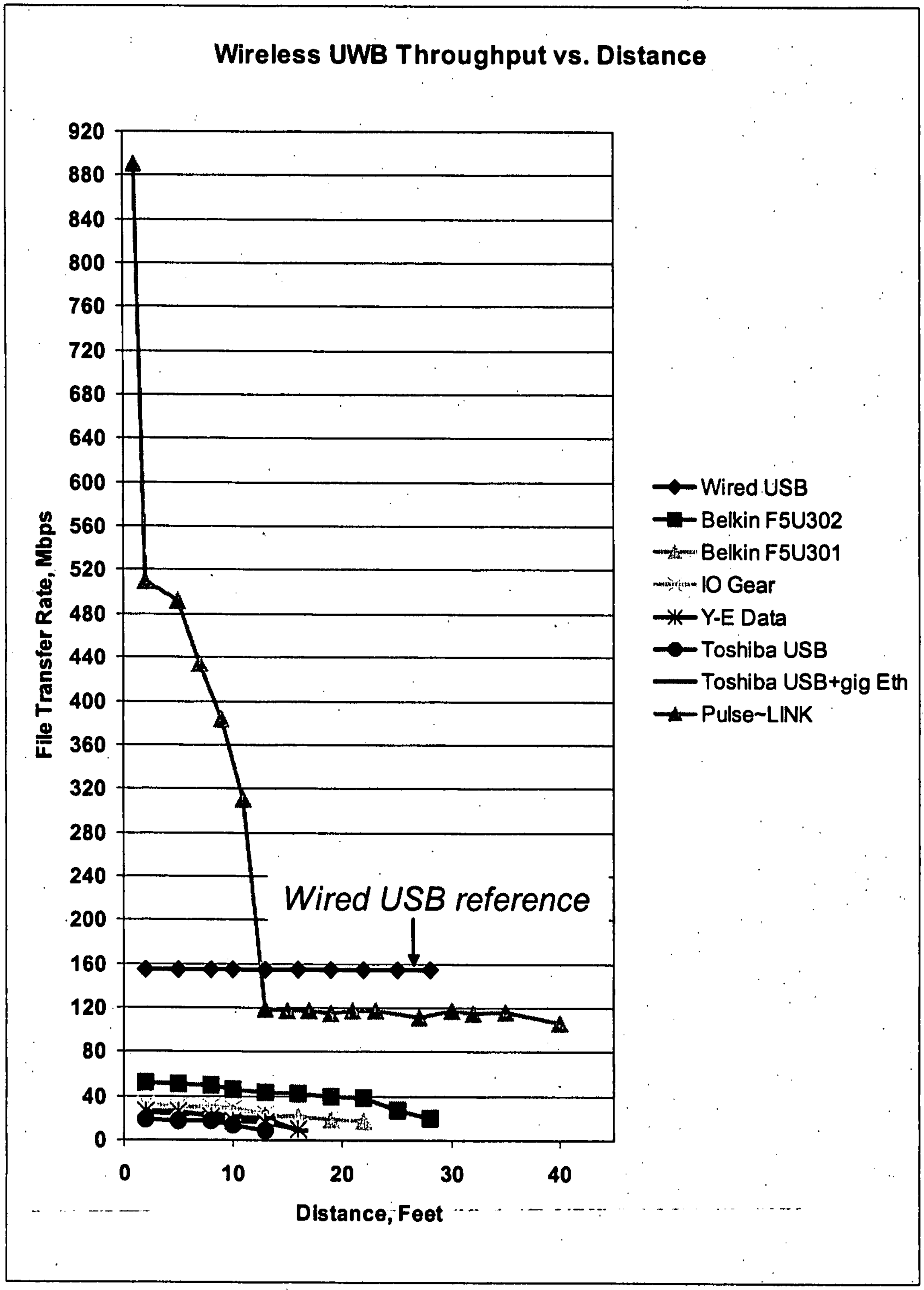

Wireless UWB Throughput vs. Distance
File Transfer Rate, Mbps
920
880
840
800
760
720
680
640
600
560
520
480
440
400
360
320
280
240
200
160
120
80
40
0
0
10
20
30
40
Distance, Feet
Wired USB reference
Wired USB
Belkin F5U302
Belkin F5U301
IO Gear
Y-E Data
Toshiba USB
Toshiba USB+gig Eth
Pulse~LINK

Figure 15: *Wireless UWB throughput vs. distance including the Pulse-LINK throughput. The Pulse-LINK device reached 890 Mbps at short range.*

Table 5: *Pulse-LINK coaxial performance*

Average TCP Throughput	Cable 1 Cable 2 Cable 3	# of Splitters*	Coaxial cable plant
498 Mbps	RG-59, 75 ft	0	75 ft
497 Mbps	RG-59, 75 ft RG-59, 75 ft	1	150 ft
497 Mbps	RG-59, 150 ft RG-59, 75 ft	1	225 ft
499 Mbps	RG-59, 150 ft RG-59, 75 ft RG-59, 75 ft	2	300 ft
499 Mbps	RG-6, 450 ft	0	450 ft
115 Mbps	RG-6, 450 ft RG-59, 75 ft	1	525 ft

* *RCA 2-Way Signal Splitter VH47, 5 to 900 MHz*

Analysis of Results

While questions remain about the reasons for the low levels of throughput exhibited by the WiMedia devices, we were impressed by the performance of CWave.

Regarding the lower than expected throughput of WiMedia, while it is possible that early drivers are to blame, it is difficult to explain the 10:1 ratio of the claimed data rate (480 Mbps) to the actual measured throughput. We were, after all, measuring a point-to-point link with little overhead for medium access. We were transferring a very large file (419

MB) and one would hope that even a bad driver would send maximum size frames for such a transfer, incurring minimal MAC and driver overhead. Still, the top WiMedia transfer rate was about a third of what we measured over the wired USB for the same file and with the same USB disk drive.

The WiMedia vendors claim that the low throughput is caused by the need to interface the wireless driver through the existing USB drivers in the PCs. They expect throughput to improve by a factor of 2:1 on the HWA and DWA sides of the link (a 4:1 combined improvement) when native drivers are implemented. We were unable to validate their claims, but are ready to perform another test on the next generation of devices.

WiMedia data throughput issues aside, the limited range of WiMedia devices is another cause for concern. Even accepting the limited throughput as a driver related issue, the short range is solely a function of WiMedia's radio performance.

At this point, it seems more probable that the simplicity of the original impulse-based modulation may explain the robustness and performance advantages of CWave over WiMedia.

Conclusion

We have measured early UWB implementations using two key technologies available today: CWave and WiMedia. While WiMedia has been implemented by the majority of UWB vendors, this technology so far has demonstrated less than optimum performance. Has most of the market made a mistake following one another into the WiMedia camp? WiMedia vendors tell us that new and more capable products are on the way. We are ready to run another test that may demonstrate the true potential of WiMedia.

The results we have today reveal that the original pulse-based UWB modulation implemented by Pulse-LINK stands high above the WiMedia crowd with 500+ Mbps application layer throughput for CWave vs. 50 Mbps application layer throughput for WiMedia. Pulse-LINK's CWave technology has delivered on the promise of UWB – HD video distribution.

With over 500 Mbps of wireless and coaxial throughput and a powerful QoS enabled MAC capable of controlled and predictable performance over multiple media in the house, CWave appears to be the clear technical leader in home networking and is well positioned to emerge as the 21st century architecture for full-home multimedia connectivity.

Acknowledgements:

We would like to thank Agilent, ETS-Lindgren and Ixia for providing the equipment for our test. Agilent has provided the E4440A PSA Series Spectrum Analyzer and ETS Lindgren has provided Model 3117 Double-Ridged Waveguide Horn antenna for UWB spectrum measurements. Both the analyzer and the antenna cover the entire UWB frequency band from 3.1 to 10.6 GHz. Ixia has provided IxChariot for IP layer throughput measurements.

octoScope

References:

[1] [insert reference to print issue of EE Times]

[2] [insert URL to IEEE sidebar]

[3] [insert URLs to EE Times announcement]

[4] [insert URL to part I]

[5] [insert URL to part 2]

[6] [insert URL to part 3]

Authors:

Fanny Mlinarsky (fm@octoscope.com) is the President of octoScope, a consulting firm focusing on architecture and performance of wireless data communications systems;

John Ziegler (john.ziegler@octoscope.com) is a data communications software development consultant with experience in communications protocols including 802.11, SIP, and a variety of voice and video technologies.

Contact:

Fanny Mlinarsky
octoScope, Inc.
Bolton, MA
fm@octoscope.com
978-376-5841

Exhibit 2

WATCH WHAT WE CAN DO
See our video demonstration >

Visit
our Ultra Wideband Blog >

JOIN
the Tzero mailing list >

Press Releases

Back to Press Releases

UTStarcom, Tzero to Demonstrate Next-Generation IPTV Set-top Boxes with Integrated Ultra Wideband Technology at ITU Telecom World 2006

Tzero Provides Advanced High-speed Video Technology

HONG KONG – December 4, 2006 – At the ITU Telecom World 2006 show in Hong Kong this week, UTStarcom, Inc. (Nasdaq: UTSI), a global leader in IP-based, end-to-end networking solutions and services, teams up with Tzero Technologies to demonstrate a new generation of IPTV set-top boxes with integrated wideband (UWB) technology. New offerings like the UTStarcom product will enable service providers to distribute high-definition video streams wirelessly within a home and dramatically reduce their installation and equipment costs.

"UTStarcom prides itself on empowering customers to quickly deploy revenue-generating access services with one ultimate objective: cost-efficient, end-to-end IP networks," said Brian Caskey, vice president of worldwide marketing at UTStarcom. "Connecting consumer electronics throughout a home via ultra wideband, and specifically Tzero, will allow service providers to deliver a range of advanced services, including IPTV, wirelessly, while sliding costs in the process."

Tzero is the leading supplier of UWB solutions including those for high-definition video applications. The company's advanced technology can connect a range of A/V components – displays, set-top boxes, digital video recorders, media center PCs, residential gateways and more. Unlike proprietary offerings, Tzero's platform is based on standards from the WiMedia Alliance and is guaranteed to coexist with other WiMedia-compliant devices.

"The combination of UTStarcom and Tzero technology can provide an exceptional value in the marketplace," said Mike Gulett, president and CEO of Tzero. "UTStarcom can easily bring video into the home, and Tzero can handle the distribution of that video throughout the home without the need for any new wires. Service providers that adopt this solution will be able to quickly differentiate themselves, gain consumer mindshare and marketshare."

For more information about other Tzero offerings, visit www.tzerotech.com or call (408) 328-5000.

About UTStarcom, Inc.
UTStarcom is a global leader in IP-based, end-to-end networking solutions and international service and support. The company sells its broadband, wireless, and handset solutions to operators in both emerging and established telecommunications markets around the world. UTStarcom enables its customers to rapidly deploy revenue-generating access services using their existing infrastructure, while providing a migration path to cost-efficient, end-to-end IP networks. Founded in 1991 and headquartered in Alameda, California, the company has research and design operations in the United States, Canada, China, Korea and India. UTStarcom is a FORTUNE 1000 company.

For more information about UTStarcom, visit the company's Web site at www.utstar.com.

About Tzero Technologies, Inc.
Tzero Technologies is the leader in wireless video. The company's advanced ultra wideband technology can connect a range of A/V components – displays, set-top boxes, digital video recorders and more – without cabling throughout the home. Founded in 2003, Tzero is backed by tier-one venture partners, including August Capital, Lightspeed Venture Partners, Mivon Venture Partners, OVP, USVP and VentureTech Alliance. Tzero is headquartered in Sunnyvale, Calif. For more information, visit Tzero online at www.tzerotech.com.

###

PR Contact:
Layla McHale
for Tzero Technologies
408-981-6394
lmchale@pacbell.net

Matt Keowen
Tzero Technologies, Inc.
408-328-5000
matt.keowen@tzerotech.com

Back to Press Releases

2006 Copyright Tzero Technologies. All Rights Reserved.

Perspective on Trusted Zones

HANA CPWG Meeting
7 December, 2006

tzero™
Watch what we can do.

Mike Coop
VP, Strategic Alliances
mcoop@tzerotech.com

About Tzero Technologies

- Focus: Broadcast-quality video delivery using ultra-wideband
- Founded in 2003, based in Sunnyvale, CA
- Experienced semiconductor-focused management team
  - Founder contributed to multiple wireless developments: 802.11 products/core patents; MIMO for 802.11 and WiMAX
  - ~20% of employees are Ph.D.'s
- Backed by top-tier venture funds
  - August Capital, Lightspeed, Miven, OVP, USVP, TSMC/VTA
  - $43M invested through series B
- Working on (closed door) CES demo of HANA multi-room connectivity using 1394 over (WiMedia standard) UWB over coax; may be shown at HANA reception

WiMedia: The UWB standard

- WiMedia ALLIANCE ~300 members, including:

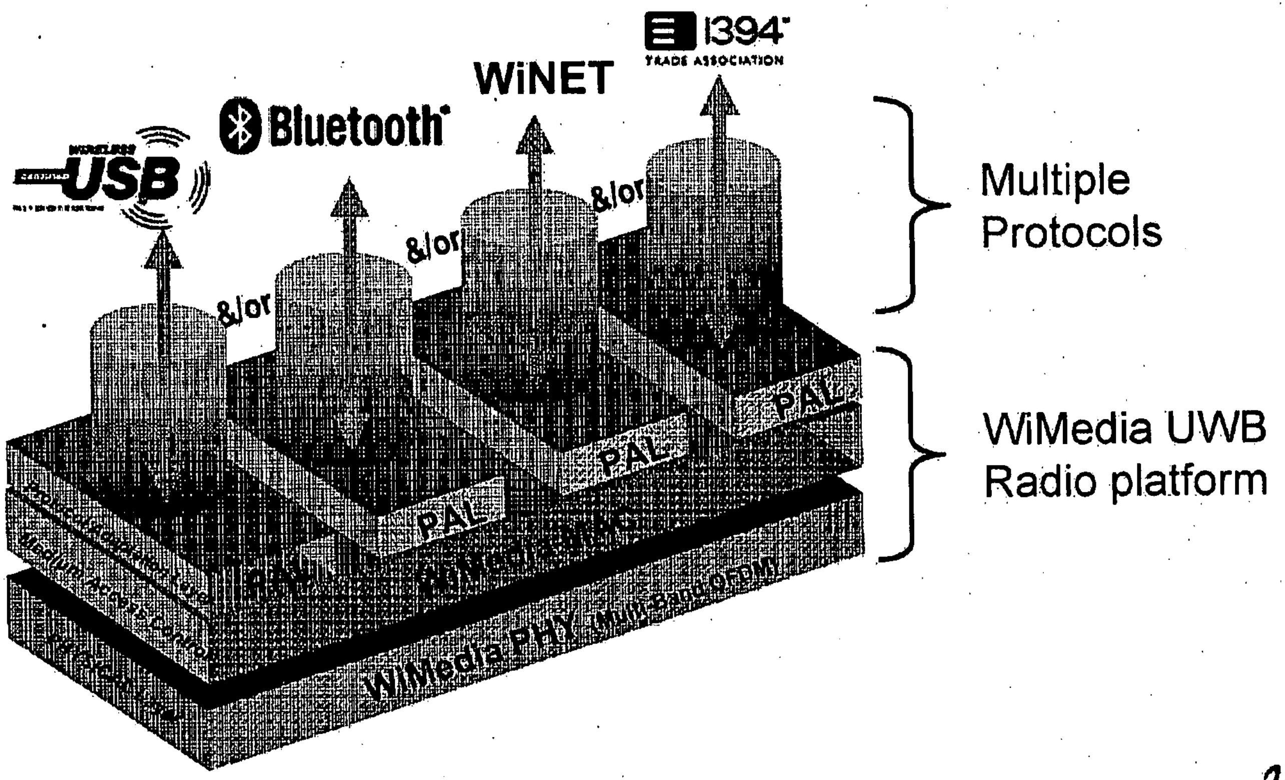
SONY, SAMSUNG ELECTRONICS, PHILIPS, SHARP, LG Electronics, Microsoft, intel, MITSUBISHI ELECTRIC, Kodak, hp, tzero

- Includes Wireless USB, WiNET, Bluetooth, and Wireless 1394
- WiMedia MAC adopted by Bluetooth SIG for PHY and MAC layers for Bluetooth 3.0

- Bluetooth > 6000 members, including:

agere systems, ERICSSON, IBM, intel, Microsoft, Motorola, NOKIA, TOSHIBA

WiMedia Single Radio Platform


1394
TRADE ASSOCIATION
WiNET
Bluetooth
WIRELESS
USB
&/or
&/or
&/or
PAL
PAL
PAL
WiMedia PHY
Multiple
Protocols
WiMedia UWB
Radio platform

tzero

Thoughts On Getting Into the Trust Zone

- IP is great, but not a panacea
- Single remote and simple setup are key; setting up crypto on a TV is badbadbadbadbad
- HD is being securely streamed over wireless *today*
- AES-128 is a core component within the WiMedia standard for link security; use dramatically lessens risk for higher layer key exchange by ensuring link authentication
- NIST provides the world's *only* independent cryptographic validation
- FIPS 197 defines requirements for validation of the AES algorithm
- FIPS 140-2 defines requirements for validation of a cryptographic module; items include...
  - Privacy and message authentication
  - Key establishment/random number generation
  - Key management
  - Tamper resistance
  - Roles & services

AES Use in Government

FACT SHEET

CNSS Policy No. 15, Fact Sheet No. 1
National Policy on the Use of the Advanced Encryption Standard (AES) to Protect National Security Systems and National Security Information

(6) The design and strength of all key lengths of the AES algorithm (i.e., 128, 192 and 256) are sufficient to protect classified information up to the SECRET level. TOP SECRET information will require use of either the 192 or 256 key lengths. The implementation of AES in products intended to protect national security systems and/or information must be reviewed and certified by NSA prior to their acquisition and use.

Demo

- Wireless for HDMI Solution

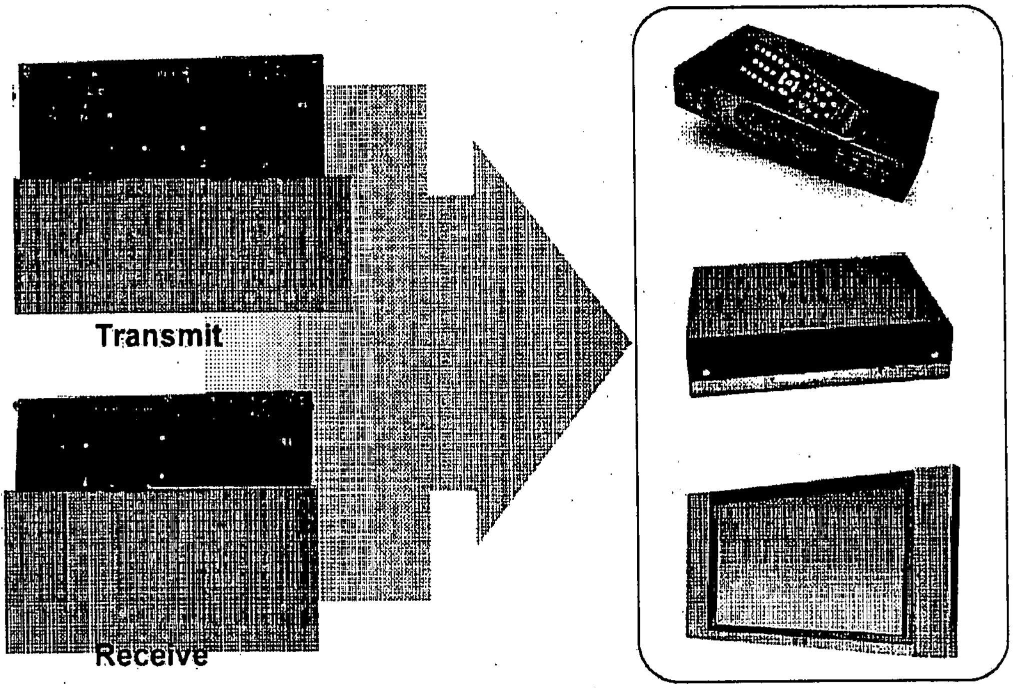

Transmit
Receive

Exhibit 4

Introduction to WiMedia Ultra Wideband Communications

Presenter: **Todd Krein**

tzero™
Watch what we can do.

Presented to the 1394TA, WWG
4-3-2007

Overview of WiMedia

- WiMedia is a high performance UWB solution
  - Data rates up to 480Mbps in V1.0
  - Industry standard TDMA MAC for both isochronous and asynchronous traffic
  - Based on proved OFDM PHY technology
  - Whole home coverage with existing splitters and cables
  - Completely compatible with CATV and Satellite signals

UWB Standards

- 2002 - 2006: standards wars
  - Within IEEE 802.15.3a working group
  - WiMedia vs. UWB forum, stalemate
  - 802.15.3a group terminates work early 2006
- WiMedia emerges as de-facto industry standard
  - Two international standards in ECMA
    - ECMA-368
    - ECMA-369
  - One international standard in ETSI
    - ETSI TS 102 455
  - Two international standards in ISO
    - ISO/IEC 26907:2007
    - ISO/IEC 26908:2007
  - Adopted for next generation Bluetooth
  - Adopted by the USB implementers forum for Wireless USB

WiMedia Alliance

- Global industry organization
- Over 275 members
  - Most big CE and computer companies
- Promote UWB for high-speed WPAN applications
- Promote worldwide UWB spectrum regulations
- Compliance & interoperability testing
- Certification of WiMedia products
- Establish WiMedia consumer brand

tzero

Member Companies (Just a sample...)

- Intel, Microsoft, AMD, Verizon
- HP, Sony, Nokia, Samsung, Dell, Canon, LG
- TI, NXP, ST, Hitachi, Marvell, Matsushita, Mitsubishi, NEC
- Agilent, Analog Devices, Broadcom, CSR, LeCroy, Sigma Designs, Tektronix, Toshiba, Oxford
- Agere, Alps, Atmel, DaimlerChrysler, IntellaSys, RFMD, Rohde&schwarz, Sanyo, Seiko-Epson, VIA, Zoran, Siemens
- Lite-On, Jabil, MITAC

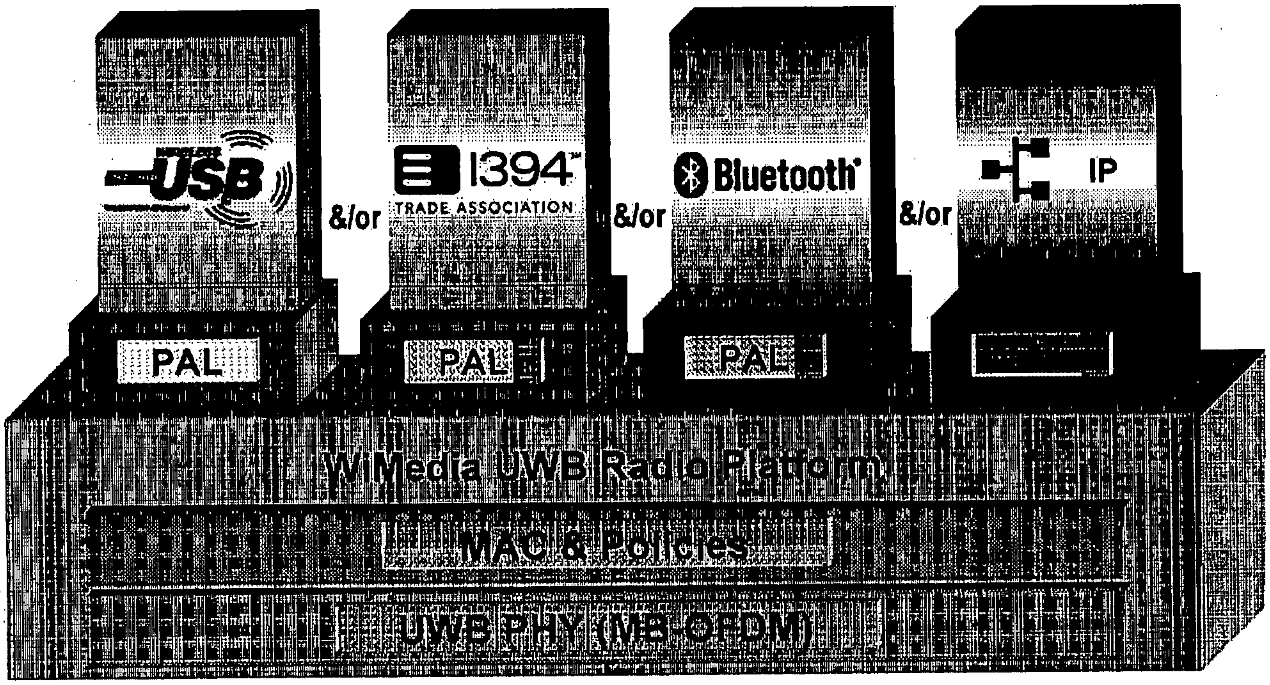
- Etc., Etc., Etc.

WiMedia Status

- Multiple chip sets available today
  - Alereon, Artimi, Focus Enhancements, Intel, Realtek, Tzero, WiQuest, Wisair
- Multiple products shipping a/o announced
  - Belkin, Y-E Data, Mitac, AudioVox, Gefen
- Enjoys strong support from test equipment manufacturers
  - LeCroy, Agilent, Ellisys, Catalyst have WiMedia specific test gear

tzero

WiMedia Platform


USB
&/or
1394
TRADE ASSOCIATION
&/or
Bluetooth
&/or
IP
PAL
PAL
PAL
WiMedia UWB Radio Platform
MAC & Policies
UWB PHY (MB-OFDM)

PAL: Protocol Adaptation Layer

Certified Wireless USB

- Developed by USB Implementer's Forum (USB-IF)
  - Responsible for certification and compliance testing
  - Responsible for logo licensing
- Runs W-USB protocol on top of WiMedia MAC protocol
- USB cable replacement
- For host computer - peripheral communication
  - Star topology

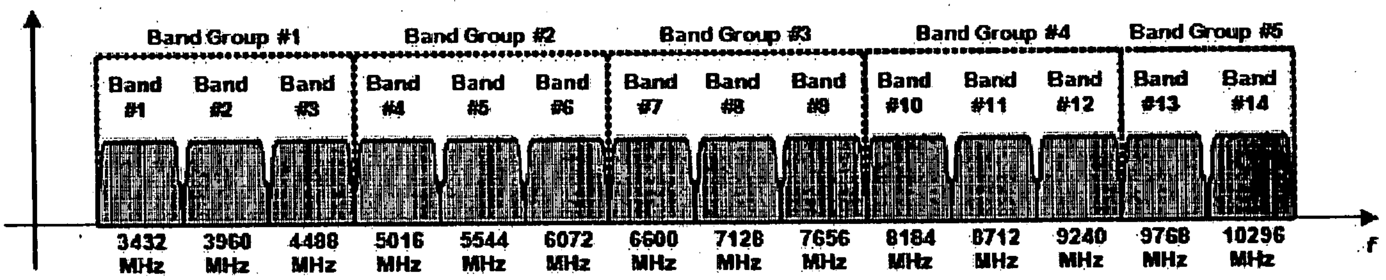
WiMedia WiNET

- Transfer of network layer packets (e.g. IP) over WiMedia radio platform
- Defines support for 802.1D bridging
- Provides ISO/OSI Layer 2 services to higher layers
- Examples of usage
  - UWB connectivity for IP stacks
  - Ethernet-to-UWB bridges
  - Wireless repeaters

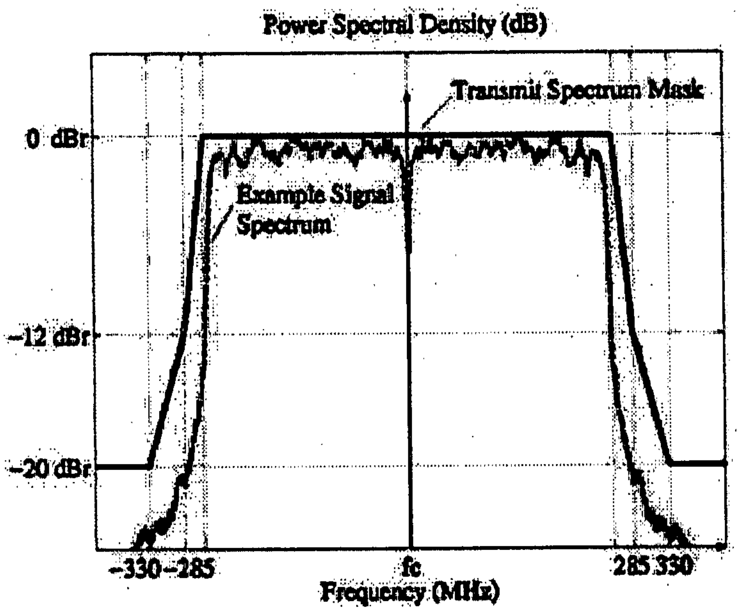
Bluetooth

- Today's Bluetooth
  - Low-speed, low-power narrowband technology in 2.4 GHz band
- Bluetooth SIG selected WiMedia UWB technology for high-speed applications in next-generation Bluetooth
  - Big boost to both Bluetooth SIG and WiMedia
- Bluetooth SIG and WiMedia groups working on integration
  - First products likely 2 years out

Transmission Bands


Band Group #1
Band Group #2
Band Group #3
Band Group #4
Band Group #5
Band #1
Band #2
Band #3
Band #4
Band #5
Band #6
Band #7
Band #8
Band #9
Band #10
Band #11
Band #12
Band #13
Band #14
3432 MHz
3960 MHz
4488 MHz
5016 MHz
5544 MHz
6072 MHz
6600 MHz
7128 MHz
7656 MHz
8184 MHz
8712 MHz
9240 MHz
9768 MHz
10296 MHz
f

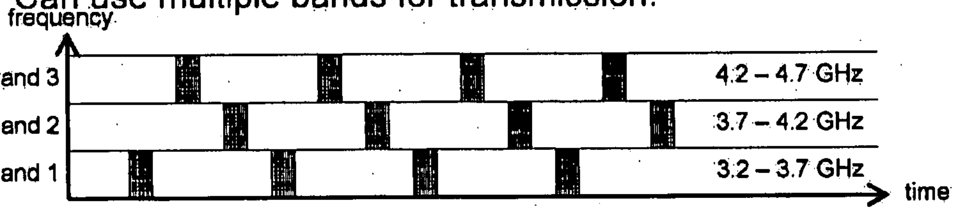
Transmit PSD


Power Spectral Density (dB)
Transmit Spectrum Mask
0 dBr
Example Signal Spectrum
−12 dBr
−20 dBr
−330 −285
fc
285 330
Frequency (MHz)

tzero

WiMedia Physical Layer (PHY)

- Based on Multiband OFDM technology
  - OFDM used in narrowband technologies, e.g. 802.11a/g
    - transmits many bits per symbol (up to 150 bits/symbol)
  - Can use multiple bands for transmission:


frequency
Band 3
Band 2
Band 1
4.2 – 4.7 GHz
3.7 – 4.2 GHz
3.2 – 3.7 GHz
time

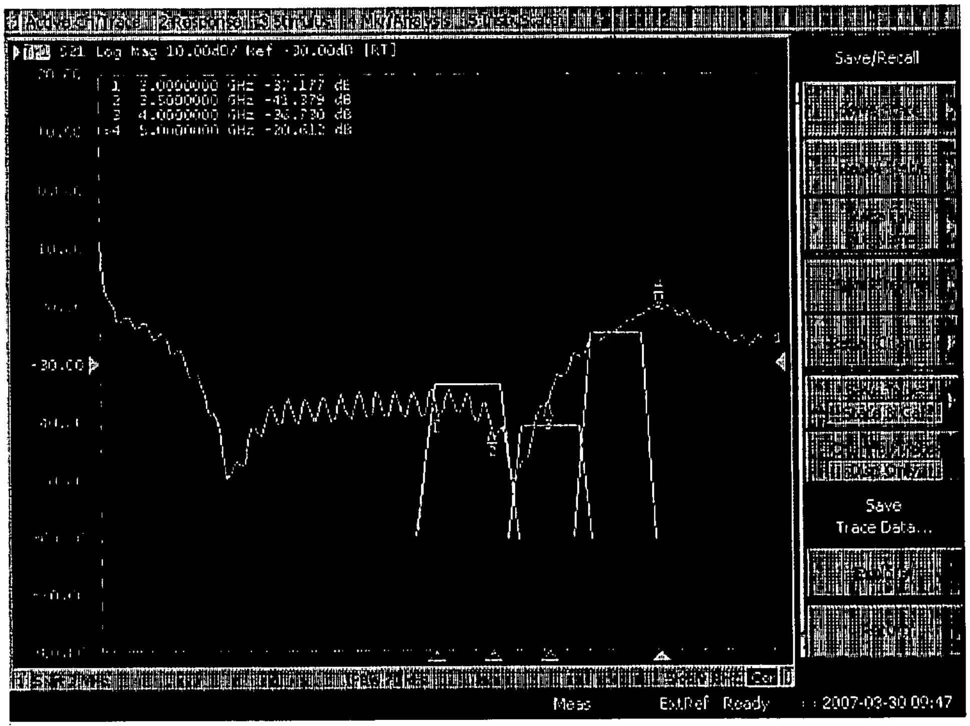
    - Pattern of band hopping defines virtual channel
- Currently 53 up 480 Mbps (356Mbps sustained)
  - higher speeds in progress
    - Looking at migration of DCM to 16-QAM
    - Band bonding
- Has integral ranging

Coax PHY Optimizations

- No hopping.
  - FCC limit doesn't apply, so hopping provides no advantage
  - Can pick "optimal" band for the home
    - Can even run below band one, e.g. 1.5GHz
  - Can run multiple independent segments on same coax via frequency multiplexing
  - Narrower operating bandwidth means
    - Less stringent linearity requirements
    - less expensive components
- Much higher output power
  - Currently running +15dBm

WiMedia Can Pick Optimal Band

- For coax, there's no advantage to band hopping – Not FCC limited on transmit power


S21 Log Mag 10.00dB/ Ref -30.00dB [R1]
Save/Recall
-30.00
Save
Trace Data...
Meas
ExtRef Ready
2007-03-30 09:47

tzero

Phy Timing Parameters

Parameter	Description	Value
f_s	Sampling frequency	528 MHz
N_{FFT}	Total number of subcarriers (FFT size)	128
N_D	Number of data subcarriers	100
N_P	Number of pilot subcarriers	12
N_G	Number of guard subcarriers	10
N_T	Total number of subcarriers used	122 (= $N_D + N_P + N_G$)
D_f	Subcarrier frequency spacing	4.125 MHz (= f_s / N_{FFT})
T_{FFT}	IFFT and FFT period	242.42 ns (Δ_f^{-1})
N_{ZPS}	Number of samples in zero-padded suffix	37
T_{ZPS}	Zero-padded suffix duration in time	70.08 ns (= N_{ZPS} / f_s)
T_{SYM}	Symbol interval	312.5 ns (= $T_{FFT} + T_{ZPS}$)
F_{SYM}	Symbol rate	3.2 MHz (= T_{SYM}^{-1})
N_{SYM}	Total number of samples per symbol	165 (= $N_{FFT} + N_{ZPS}$)

Current Transmit Rates

Data Rate (Mb/s)	Modulation	Coding Rate (*R*)	FDS	TDS	Coded Bits / 6 OFDM Symbol (N_{CBP6S})	Info Bits / 6 OFDM Symbol (N_{IBP6S})
53,3	QPSK	1/3	YES	YES	300	100
80	QPSK	1/2	YES	YES	300	150
106,7	QPSK	1/3	NO	YES	600	200
160	QPSK	1/2	NO	YES	600	300
200	QPSK	5/8	NO	YES	600	375
320	DCM	1/2	NO	NO	1 200	600
400	DCM	5/8	NO	NO	1 200	750
480	DCM	3/4	NO	NO	1 200	900

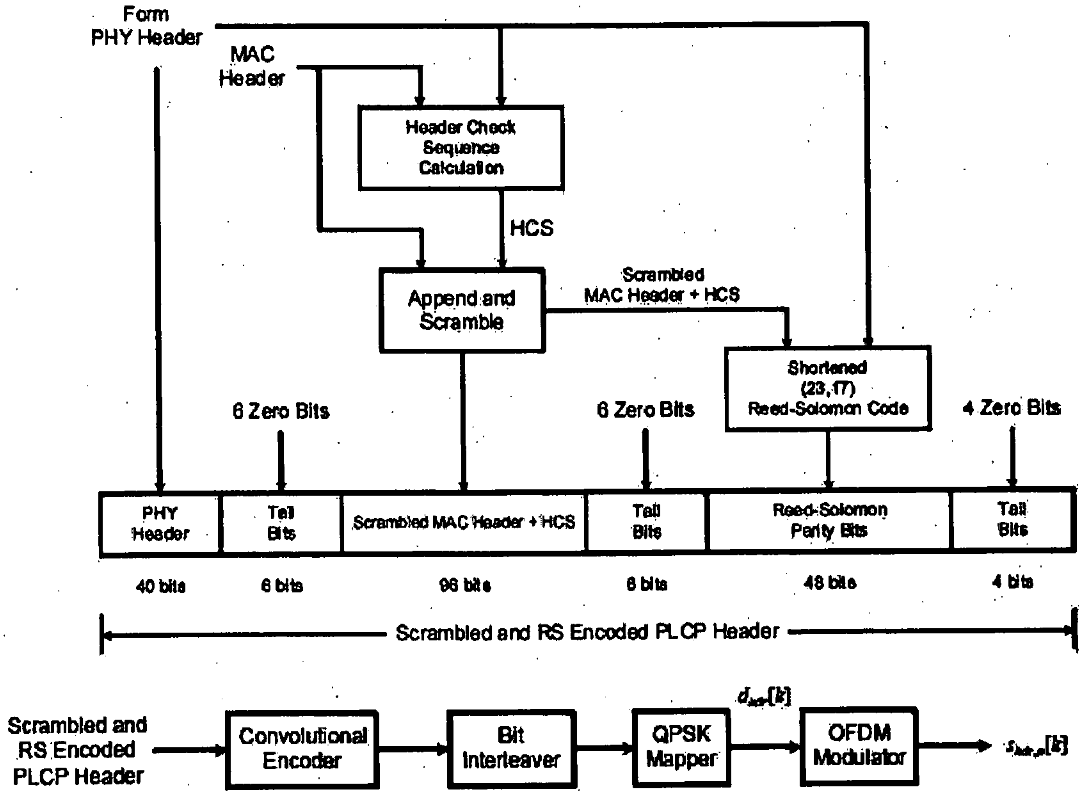
Required Sensitivity

Data Rate (Mb/s)	Minimum Receiver Sensitivity (dBm)
53,3	–80,8
80	–78,9
106,7	–77,8
160	–75,9
200	–74,5
320	–72,8
400	–71,5
480	–70,4

- Tzero's implementation is significantly better than this

tzero

Transmitter Architecture

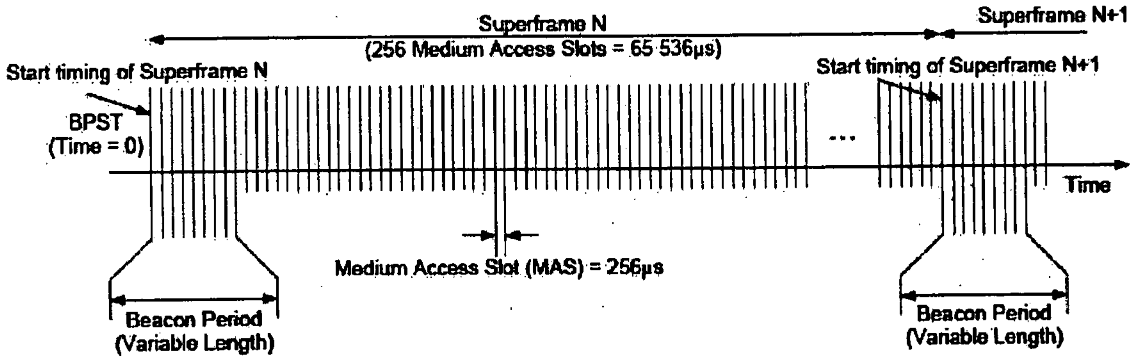

Form
PHY Header
MAC
Header
Header Check
Sequence
Calculation
HCS
Append and
Scramble
Scrambled
MAC Header + HCS
Shortened
(23,17)
Reed-Solomon Code
6 Zero Bits
6 Zero Bits
4 Zero Bits
PHY
Header
Tail
Bits
Scrambled MAC Header + HCS
Tail
Bits
Reed-Solomon
Parity Bits
Tail
Bits
40 bits
6 bits
96 bits
6 bits
48 bits
4 bits
Scrambled and RS Encoded PLCP Header
Scrambled and
RS Encoded
PLCP Header
Convolutional
Encoder
Bit
Interleaver
QPSK
Mapper
OFDM
Modulator

tzero

WiMedia Medium Access Control (MAC)

- Uses Time Division Multiple Access (TDMA)
  - Transmitters synchronize transmissions as to not transmit at the same time
  - Time reservations for isochronous traffic
  - Contention-based access during non-reserved slots
- Distributed channel access and network control
  - No central network controller – more robust
  - Peer-to-peer communication
- Quality of Service (QoS) support for
  - Asynchronous traffic
  - Isochronous traffic
- Link layer security
  - Built-In Authentication and Encryption (AES)

MAC Superframe


Superframe N
(256 Medium Access Slots = 65 536µs)
Superframe N+1
Start timing of Superframe N
Start timing of Superframe N+1
BPST
(Time = 0)
...
Time
Medium Access Slot (MAS) = 256µs
Beacon Period
(Variable Length)
Beacon Period
(Variable Length)

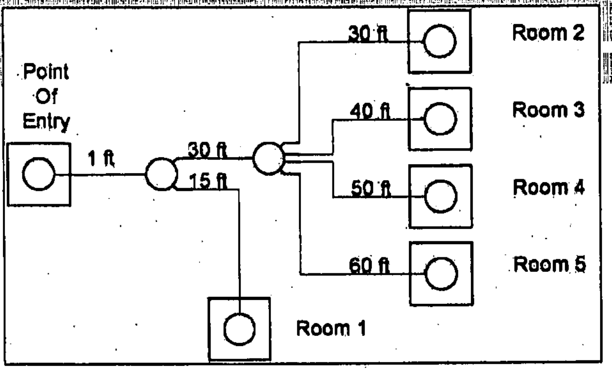
Frame Format

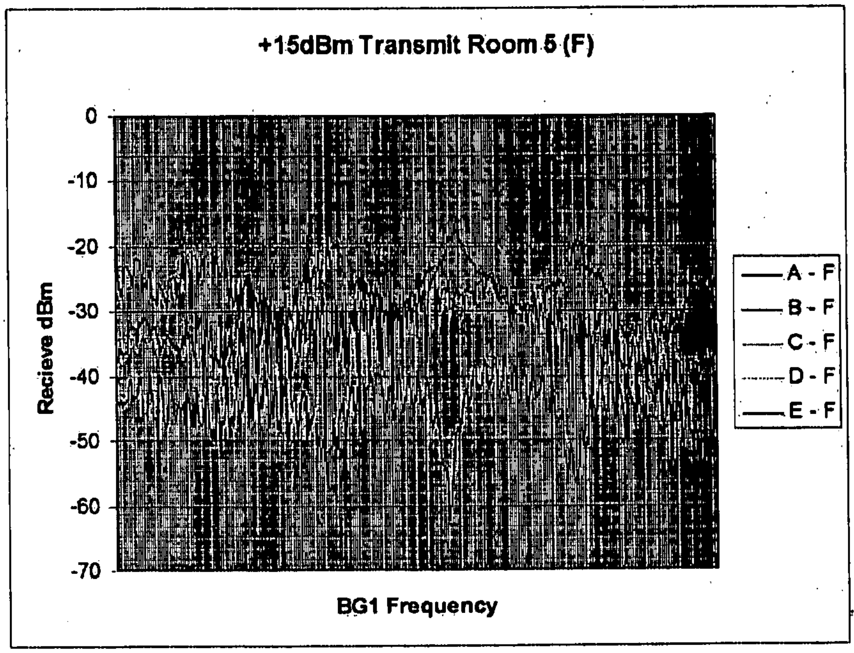
Preamble	PHY+ MAC Header	Frame Payload (0 – 4095 bytes)
	39.4 Mbps	53.3, 80, 106.7, 160, 200, 320, 400, 480 Mbps

- Headers transmitted at 39.4Mbps
- Payload at 53.3 – 480Mbps
  - Allows for greater flexibility, range, interoperability

tzero

Typical Home


Point
Of
Entry
1 ft
30 ft
15 ft
30 ft
Room 2
40 ft
Room 3
50 ft
Room 4
60 ft
Room 5
Room 1


+15dBm Transmit Room 5 (F)
0
-10
-20
-30
-40
-50
-60
-70
Recieve dBm
BG1 Frequency
A - F
B - F
C - F
D - F
E - F

tzero

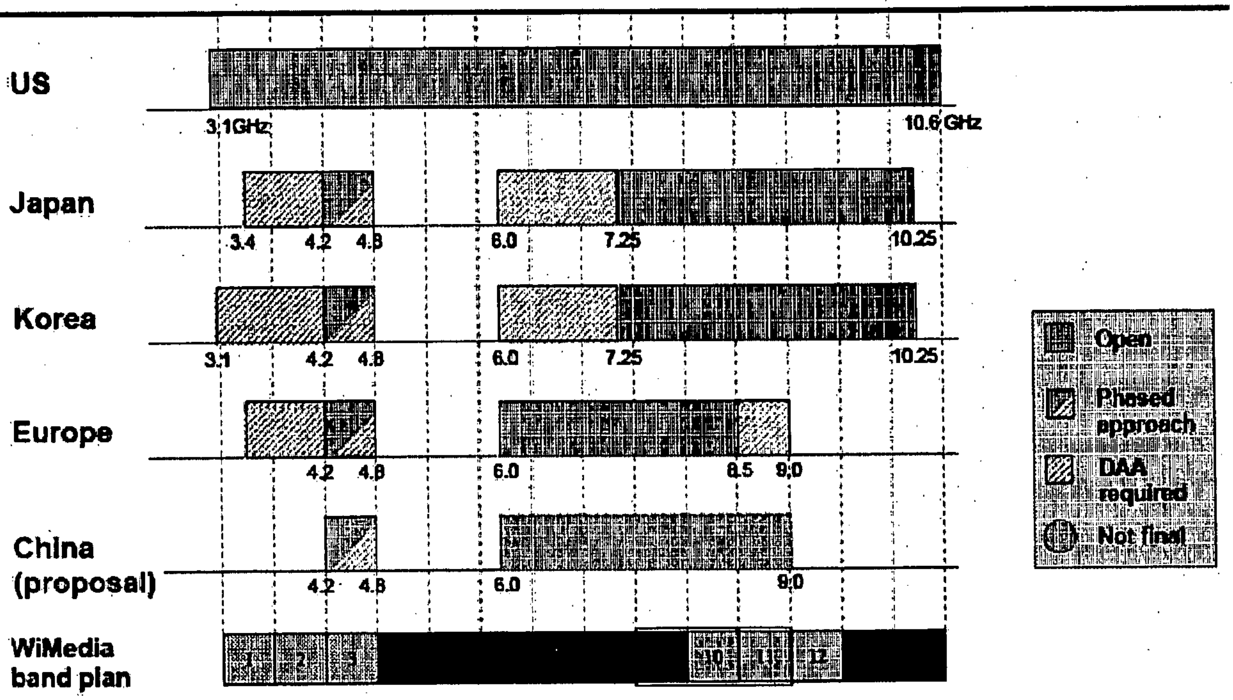
Current Results

- Full Bandwidth at approximately 87dB link margin
- 550 ft of RG6
- 365ft RG-6, through 2-way, across 4-way
- 300ft RG-6, through two 2-ways, across 4-way
- 190ft RG59, through two 2-ways, across 4-way
- Every path in the HIAB
  - PER ~ 10E-5, without retransmissions

Compatibility with Wireless

- If we want to enable wireless 1394, WiMedia allows a seamless transition
- WiMedia has Detect And Avoid
  - Required in most countries outside of US
- WiMedia is band-agile
  - All current implementations cover at least band group 1
  - Design makes it easy to move to lower frequencies

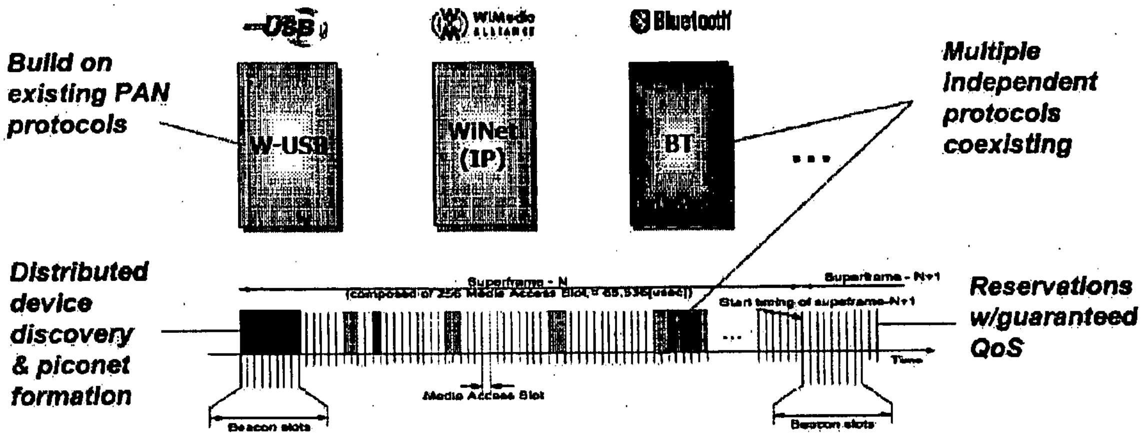
Worldwide Regulatory Landscape



US
3.1GHz
10.6 GHz
Japan
3.4
4.2
4.8
6.0
7.25
10.25
Korea
3.1
4.2
4.8
6.0
7.25
10.25
Europe
4.2
4.8
6.0
8.5
9.0
China (proposal)
4.2
4.8
6.0
9.0
WiMedia band plan
1
2
3
10
11
12
Open
Phased approach
DAA required
Not final

tzero™

WiMedia Common Radio Platform



Build on existing PAN protocols
W-USB
WiNet (IP)
BT
Multiple independent protocols coexisting
Distributed device discovery & piconet formation
Superframe - N
Superframe - N+1
Start timing of superframe-N+1
Media Access Slot
Beacon slots
Time
Reservations w/guaranteed QoS

- Current support for multiple industry standard protocols makes it the best choice for MSOs and Service Providers

Summary

- WiMedia **is** the industry standard
- Completely open standard
- Compatible world-wide
- High performance, high reliability
- Multiple silicon and system venders
  - Competition keeps prices low, innovation high
  - Multiple sources are an industry requirement

WiMedia is not just a technology
It's an ecosystem, a full solution

tzero

tzero

Korean | Japanese | Chinese

Watch what we can do.

COMPANY
PRODUCTS
TECHNOLOGY
APPLICATIONS
NEWS & EVENTS

Press Releases
2007
2006
2004
Recent News
Events
Awards

See our video demonstration >

Visit the Ultra Wideband Blog >

Get the latest information on Tzero products >

Join the Tzero mailing list >

Press Releases

Tzero Unveils New Ultra Wideband Chipset for Home Entertainment Networking

New ZeroWire™ Solution Delivers Wired and Wireless Performance More Than 2X Greater Than Competing Technologies

SUNNYVALE, CALIF. - June 12, 2007 - Tzero Technologies today announced its new ZeroWire chipset (TZC7200), the first WiMedia® standards-based, ultra wideband (UWB) semiconductor solution optimized for real-time delivery of high-definition video, wirelessly and over wires. The ZeroWire chipset enables service providers to create networks for distributing entertainment content throughout the entire home using existing coax cable. The chipset also gives consumer electronics manufacturers the ability to create new classes of wireless video devices – HDTVs, digital video recorders, and more – that are easier and less expensive to install.

"The home entertainment market is rapidly moving to high-definition digital content. Service providers are creating the networks to deliver it. Consumer electronics companies are building products to store and display it. But neither group has had an effective way for distributing and connecting that content around the home, until today," said Mike Gulett, president and CEO of Tzero. "Now, Tzero's ZeroWire chipset gives both CE manufacturers and service providers a standards-based solution that can cover the whole home with high definition by using a combination of wired and wireless links. No other chipset can provide this capability."

Solutions for Service Providers and CE Manufacturers

ZeroWire opens the doors for service providers to expand next-generation broadband and IPTV services. It delivers the performance and sustained throughput to support multiple high-definition video streams. Because it works over existing coax cabling, it significantly reduces the cost of installation.

"As part of our effort to design a robust industry standard solution for delivering high-definition content around the home, Tzero has been a key partner for Samsung," said Dr. Heemin Kwon, executive vice president of Samsung. "Tzero has worked closely with us to extend ultra wideband wireless technology to support an open standard that works over existing in-home coax cabling. Combined with HANA technology, these future set-top boxes will enable carriers to create the first complete whole home high-definition A/V networking solution, which will allow consumers to share their media and devices across the home without sacrificing quality."

Consumer electronics manufacturers using ZeroWire can develop wireless video products including: wireless high-definition TVs, projectors, Blu-Ray and HD DVD players, game consoles, media adapters, and media center PCs. With ZeroWire, flat panel TVs can be placed anywhere without tearing open walls to run cabling, and video recorded in one room can be seamlessly accessed from another.

ZeroWire Capabilities

The ZeroWire chipset is optimized for wireless and wired networking of entertainment content around the home. Capabilities include:

- Performance for multiple high-definition video streams with PHY data rates of up to 480 Mbps over coax for whole-home coverage and wirelessly within rooms. The sustained data rates are more than double that of MoCA-based products and more than 10x that of WiFi solutions including those using 802.11n.

- Multiple interfaces for easy incorporation into a range of devices through PCI, transport stream and host bus interfaces.

- Broad protocol support for network connectivity and application integration including IP, UDP, TCP/IP, multicast and unicast.

ZeroWire is comprised of both a Radio Frequency IC (RFIC) as well as a baseband and media access control system-on-chip. It is WiMedia compliant and provides full WiMedia networking support for seamless sharing of entertainment content.

"Tzero uses a completely standards-based ultra wideband to deliver solutions for distributing high-definition throughout a home," said Ben Bajarin, analyst with Creative Strategies. "With major players such as Bluetooth 3.0 and Wireless USB also employing WiMedia standards, Tzero is in good company, enabling wired and wireless home entertainment networks with devices that are guaranteed to interoperate."

Availability

The Tzero ZeroWire chipset is available immediately. For more information, go to www.tzerotech.com or call 408-328-5000.

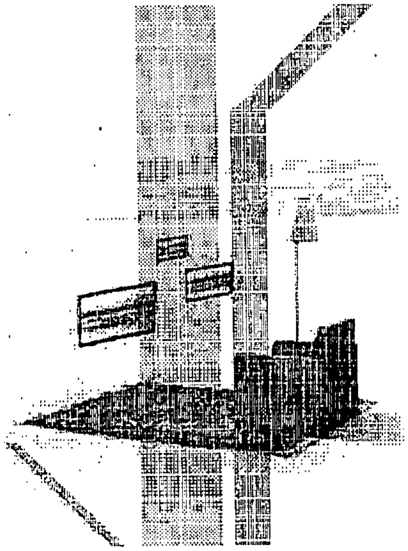
About Tzero Technologies, Inc.

Tzero Technologies is the leader in high-definition video distribution. The company's advanced ultra wideband semiconductors enable connections between a range of A/V components -- HDTVs, set-top boxes, digital video recorders and more -- without new wires. Founded in 2003, Tzero is backed by tier-one venture partners, including August Capital, Lightspeed Venture Partners, Miven Venture Partners, OVP, USVP and VentureTech Alliance. Tzero is headquartered in Sunnyvale, Calif.

###

PR Contact:
Layla McHale
for Tzero Technologies
408-981-6394
lmchale@pacbell.net

Matt Keowen
Tzero Technologies
408-328-5000
matt.keowen@tzerotech.com



©2007 Tzero Technologies. All Rights Reserved. Home | Contact Us | Support

Exhibit 6

tzero™
Watch what we can do.

A Retailer's Guide to ZeroWire™ HDMI

The Value Proposition

Shrinking margins and time-consuming installations, these are two key elements which plague today's flat-panel TV market. Retailers and manufacturers need improved differentiation. Consumers need simpler and easier-to-install products. ZeroWire HDMI™ addresses both issues, providing a compelling new feature – the ability to deliver high-definition content without wires from source to HDTV. And with no cumbersome cables to run, installation cost and complexity are minimized.

The Purchase Criteria

ZeroWire HDMI products must deliver a high-quality viewing experience, not interfere with each other or themselves, and utilize a technology platform based on industry standards. How does that translate into requirements?

Real-time delivery of high-definition video is a must: Synchronizing content from computers or streaming low-resolution and standard definition video is no longer sufficient. Consumers want everything — including high-definition video up to 1080p — delivered in real-time to their televisions. ZeroWire HDMI seamlessly delivers content from source to display, with all the quality you expect from high-definition video.

Immunity from interference is key: Since 802.11 can't sustain sufficient throughput, or resist fading and interference, WiFi simply can't support real-time high-definition video. 802.11n merely compounds the problem — .11n's increased range will cause more interference within homes and even with devices in neighboring homes. On the other hand, the ultra wideband used by ZeroWire HDMI products is widely recognized as the ideal real-time video delivery mechanism. Immunity to interference enables ultra wideband to deliver the bandwidth required for high-definition video within rooms for optimal coverage where you need it most.

Compliance with industry standards is mandatory: Compatibility with the ultra wideband standard, as defined by the WiMedia Alliance, is a critical purchase criterion. Non-standard, proprietary products will cause interference, won't work, and will drive returns of both the accessories themselves, and of other products that use Certified Wireless USB and Bluetooth 3.0 (also based on the WiMedia standard). The tens of millions of WiMedia-compliant solutions being shipped by Intel, AMD and hundreds of other leading manufacturers will suffer from this negative impact, adding to your reverse logistics problem.

Time to market makes a difference: Any ZeroWire HDMI solution you consider must be available for the 2007 holiday season. 2008 will be *me too* for those who miss 2007. Ask if the solution is shipping in volume for the 2007 holiday season, with all the kinks worked out. Nothing will drive post-holiday returns faster than accessories which don't work.

Global market creates opportunities: ZeroWire HDMI has worldwide applicability, so a single technology solution must be distributed across various brands and product lines globally. In almost every case, proprietary solutions are prohibited from operating outside the U.S. by national regulatory constraints. If the product is WiMedia compliant, global market support isn't an issue – it's an inherent part of the specification.

Roadmaps and product extensions matter: One product isn't good enough. The initial solution must provide a platform for a variety of multiple configurations, future enhancements and cost reduction, courtesy of aggressive roadmaps applicable globally. Consider this carefully when evaluating your purchase.

The Vendor Selection

Tzero brings an unmatched product package to market, meeting all of the requirements for a successful solution. Tzero and its ZeroWire HDMI solution deliver:

- Standards compliance (WiMedia, HDMI, HDCP)
- Wireless high-definition video up to 1080p
- Immunity from interference from common household appliances and other wireless products
- Plug-and-play installation
- Global market reach and applicability
- Partnerships with industry leading manufacturers
- Multiple product configurations and aggressive roadmaps
- Availability in Fall 2007

For more information contact:

Tzero Technologies Inc.
T: (408) 328-5000
sales@tzerotech.com
tzerotech.com

© Copyright 2007. Tzero Technologies, Inc. All rights reserved. Tzero, Tzero Technologies and the Tzero logo design are trademarks or registered trademarks of Tzero Technologies.
All other trademarks and registered trademarks are the property of their respective holders.

MAY 2007

Sun	Mon	Tue	Wed	Thu	Fri	Sa
		1	2	3	4	5
6	7	8	9	10	11	1
13	14	15	16	17	18	1
20	21	22	23	24	25	2
27	28	29	30	31		

CATEGORIES

UWB Applications

UWB Futures

UWB Market

UWB Products

UWB Technology

ARCHIVES

May 2007

April 2007

March 2007

February 2007

January 2007

December 2006

November 2006

October 2006

September 2006

August 2006

May 14, 2007

Read Rick Merritt

If you're not reading Rick Merritt's blog, and you're tracking the world of connectivity, you need to. He's up to speed on just about everything going on in the space and has some very interesting insights.

I do take issue, however, with one recent post from Rick that talked about the Park's Connections Conference. In it, he contrasted two panels: one that featured the views of wireless vendors and the other that focused on those of the telcos and cable providers. His point was that the wireless wags need to pay attention to the cable camp that, guess what, is very comfortable with wires.

My issue isn't that I disagree with Rick's point, frankly I agree with him whole heartedly. But Rick should have noted that at least one wireless technology -- UWB -- has already demonstrated its ability to work over wires, coax in particular. Several suppliers of residential gateways, routers and set-top boxes are working to productize UWB over coax as an alternative to MoCA. And the WiMedia Alliance has created a study group (led by one of the major telcos) to implement this as part of the UWB standard.

Posted by Matt Keowen on May 14, 2007 at 12:49 PM in UWB Market, UWB Products, UWB Technology | Permalink | Comments (0) | TrackBack (0)

April 26, 2007

RESOURCES

UWB Domains For Sale

WiMedia Alliance

Wireless Week

Daily Wireless

Wi-Fi Planet

BLOGROLL

Anandtech

Engadget - Wireless

EngadgetHD

GigaOM

HDBlog.net

Interconnects

TechDigs

Wi-Fi Net News (Glenn Fleishman)

Wireless Weblog (Jeff Goldman)

ABOUT

BLOGGERS

Click Here to Post

ADMINISTRATIO

Login

Subscribe to this blog's feed

FEEDS

Your email address:

Get email updat

Powered by FeedBlitz

The Retailer's View

Last week, ultra wideband was one of the hot topics of conversation at the RetailVision, a Gartner Group event that attracts 200 or so buyers from national and regional chains. Tzero's ultra-wideband-based Wireless for HDMI won Best New Technology underscoring the growing interest in the application of wireless high-definition video and UWB products in general.

Even more telling were the comments from these retail buyers. One buyer commented that Wireless for HDMI was "a game changing solution." Others remarked that they could see it easily fitting into their line and that selling these products was a "no brainer." In other words, they get the value proposition -- the world is going wireless. They've seen it in the data world and now they're on the verge of it for video. Replacing the tangle of cables behind the media cabinet and simplifying installation will solve huge problems for their consumers, and those are very good things.

One cautionary note was sounded by these buyers. Their concern was over proprietary products and implementations. They want standards-based solutions that ensure interoperability. Our advice to retailers, make sure you ask if the solution you're considering is WiMedia compliant.

Posted by Matt Keowen on April 26, 2007 at 10:33 AM in UWB Market | Permalink | Comments (0) | TrackBack (0)

April 11, 2007

Monsterous Adoption of Wireless Video

MONSTER Monster -- long known as the leader in cables for high-end a/v and computing applications -- is going wireless with a new generation of products targeting the HDTV market. They've committed to developing a range of solutions using ultra wideband including a product that integrates Wireless for HDMI, conditioned power and mounting hardware all in one consumer-installable package. Pretty cool.

The new Monster-branded products will come about as the result of a partnership inked with Tzero. Monster's entry into the market further demonstrates the growing opportunity ahead for WiMedia-standards-based wireless video. Consumers are continuing to balk at high installation costs for the HDTVs. According to the Head Monster, Noel Lee, "HDTV prices are coming down, but hidden installation costs and hassles continue to shock consumers." Wireless for HDMI solves the problem. Expect to see solutions from Monster on the market in Fall 2007. Read the full press release here.

Posted by Matt Keowen on April 11, 2007 at 10:51 AM in UWB Products | Permalink | Comments (5) | TrackBack (0)

March 22, 2007

Ultra Wideband Approved as an ISO Standard

ecma INTERNATIONAL As part of Ecma 368 and 369, the WiMedia ultra wideband standards are now officially *global* standards. This was announced this week and published on the Ecma website under their Wireless Proximity Systems section. This is another huge step forward for the ultra wideband community. It should help accelerate the adoption and deployment of WiMedia-standards-based products in Europe and throughout the world.

Posted by Matt Keowen on March 22, 2007 at 11:22 AM in UWB Market, UWB Products, UWB Technology | Permalink | Comments (0) | TrackBack (0)

March 08, 2007

The Importance of a Standards-based Approach

You've heard the arguments before. Standards-based approaches are good for markets because they enable multi-vendor sourcing and reduce costs, ensure compatibility and interoperability. But in wireless communications and particularly in the emerging UWB market it's even more critical to be standards based.

Imagine as a consumer bringing home a new non-standard UWB product. Set it up and it seems to work fine. Then go to your new Wireless USB printer. It worked well before but now it doesn't. The non-standard product is interfering. Put on your Bluetooth headset and try to call tech support. It no longer works either. Which product do you return? If you're like many consumers, you return them all.

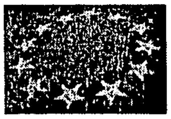
Imagine being the retailer having to take all those products back. You can't even begin to diagnose the problem. Every year, retailers receive more than $15 billion in returns because of problems like this. With nearly 300 companies soon to ship WiMedia standards-compliant products - and another 7,000 companies adopting this standard for next-generation Bluetooth devices - you can understand the magnitude of the problem that could be created by even one non-standard product.

Non-standard communications by devices result in interference and chaos, and greatly reduce the likelihood of widespread adoption. We urge all companies involved in the UWB market to take a standards-based approach, and participate in WiMedia compatibility and interoperability tests.

Posted by Rajeev Krishnamoorthy on March 08, 2007 at 02:38 PM in UWB Market, UWB Products, UWB Technology | Permalink | Comments (0) | TrackBack (0)

March 01, 2007

The EU and UWB



Last week, the European Union took another welcome step to enable the widespread adoption of ultra wideband -- in a range of applications -- beginning later this year.

The Commission of the European Communities issued a decision to approve frequencies for use of UWB devices and stated that it "must be applied within the next six months throughout the EU's 27 Member States." That's good news for all of us in the UWB community and ultimately for consumers throughout Europe.

One other key point made by the Commission included the clear identification of video distribution as an important application area for UWB. "Furthermore, video signals will be transmitted using predominantly high-efficiency coding," said the decision. This essentially mandates the use of compression and validates Tzero's Wireless for HDMI product.

See the full decision by visiting the European Commission website.

Posted by Matt Keowen on March 01, 2007 at 05:51 PM in UWB Futures, UWB Market, UWB Products | Permalink | Comments (0) | TrackBack (0)

February 21, 2007

BusinessWeek's Technology & You

BusinessWeek We had the chance to talk with Steve Wildstrom from BusinessWeek a few days ago regarding his column entitled *Juicing Up Home Networks*. The focus of the piece was on two powerline networking products and his tests of their effectiveness for distributing video content around the home.

Steve made a number of good points in his column and in the discussion. He differentiated between the marketing claims of maximum throughput for powerline -- which were purported to be 200 megabits per second (Mbps) -- and the average throughput which proved to be dramatically less, somewhere in the range of 12 to 20 Mbps. He talked about the different types of video, both standard definition or broadcast TV quality, and high definition, and the demands these two classes of content put on a network. High-definition video, according to Steve "choked" the powerline products he tested.

So if powerline isn't the solution to distributing high-definition video around the home, what is? Obviously, we believe that UWB will play a significant role in this application across a range of devices -- both wireless and wired. Steve expects to write more about this topic in the future.

By the way, if you haven't listened to Steve's Technology & You podcast , definitely give it a try.

Posted by Matt Keowen on February 21, 2007 at 07:05 PM in UWB Products, UWB Technology | Permalink | Comments (0) | TrackBack (0)

January 30, 2007

Is It The Year of UWB?

It's a good question. And what does it really mean to be the *year* of any technology? Does it mean that commercial products hit the shelves in volume? If that's the criteria, then 2007 will definitely be the year for UWB. Does it mean that the technology becomes adopted across a wide range of applications? This will also be true in 2007. Already we've seen announcements that the technology will be embedded in laptop PCs, high-definition TVs, automobiles and a range of aftermarket products designed to make the delivery of multimedia content around the home simpler and easier than ever before.

Wireless Week Magazine muses on the UWB trend in a recent article entitled *UWB Blast Off*. Tim Bajarin, analyst with Creative Strategies, writes in PC Magazine that wireless high definition and UWB will be one of the hottest themes this year, "since it represents a key to the future for content distribution within the home."

Additionally, both Wireless Net Design Line and EDN declare Tzero's UWB one of the top wireless products of the year. Even the podcasters at the HT Guys predict 2007 will be a big year for UWB. They must be onto something.

Posted by Matt Keowen on January 30, 2007 at 10:29 PM in UWB Market | Permalink | Comments (0) | TrackBack (0)

January 14, 2007

Gates' CES Short List

When you're attending a tradeshow as large as CES, it pays to make a check list of top companies to visit. That's the approach taken by Bill Gates and this year Tzero was on that list. Shortly after the show opened on January 8, Gates along with Microsoft co-founder Paul Allen made a beeline for the Tzero booth in the Central Hall to see the latest in ultra wideband.

While at the booth, Gates and Allen met with Tzero CEO Mike Gulett, and senior vice president of sales and marketing Dan Karr. They saw demonstrations of both wireless high-definition video and wired networking of entertainment content using UWB. After viewing the demonstrations, Gates observed that UWB "has certainly come a long way."

Coincidentally, Forbes reporter Rachel Rosmarin was also visiting Tzero on Monday morning. You can read her observations at www.forbes.com.

Posted by Matt Keowen on January 14, 2007 at 08:55 AM in UWB Market | Permalink | Comments (0) | TrackBack (0)

December 30, 2006

WiMedia Only

Don't be confused. The WiMedia Alliance is the only standards-setting body for ultra wideband. I don't know why, but some people still are unaware that IEEE disbanded its efforts and assigned the task to WiMedia. Others are unintentionally propping up the UWB Forum. A recent post on GigaOM is a good example of this, using that group's logo as if it's a symbol for the technology. News flash: the UWB Forum is also essentially disbanded. Their website is no longer updated and you cannot join the group even if you wanted to.

In contrast, the WiMedia Alliance is a thriving organization that is doing all the things a strong industry group should - setting standards, developing compatibility and interoperability tests, actively marketing and growing. There are now approaching 300 member companies.

For more on WiMedia, visit www.wimedia.org.

Posted by Matt Keowen on December 30, 2006 at 03:45 AM | Permalink | Comments (1) | TrackBack (0)

Press Releases

Back to Press Releases

Tzero Unveils the Industry's First Wireless Solution that Delivers Broadcast-Quality Video

Comparison Performance Testing Shows Tzero's UWB Technology at 4X Above the 802.11 Pre-n and Draft-n Figures Publicly Available

SUNNYVALE, CALIF. - June 12, 2006 - Delivering on the promise of a completely "wire-free home," Tzero Technologies today introduced the industry's first and highest- performing solution that delivers broadcast-quality video over wireless networks. The new Tzero TZ 7000 chipset, which begins shipping in July 2006, is the only wireless solution that meets the link reliability and packet error rate requirements defined by Panasonic, Philips, Samsung, Sharp and Sony. Using the Tzero UWB solution, these consumer electronics manufacturers will be able to provide a completely wireless network for connecting home entertainment systems, computers and other consumer electronic devices within a home or office.

"We are currently engaged with all the top consumer electronics, set-top box and residential gateway manufacturers and have been overwhelmed with their response to our video quality, reliability and sheer performance," said Mike Gulett, president and CEO of Tzero. "As we near production shipments, we anticipate broad and rapid adoption of the TZ 7000, and we've set up the infrastructure to handle the explosive growth those designs will bring our company."

"With the popularity of wireless computer networks, consumers and business users are asking how they can link all of their electronic devices wirelessly – whether it's their TVs, iPods, DVRs or game boxes," said Ben Bajarin, Creative Strategies. "Imagine a cable- free home where most of the boxes in our living rooms today move to a media closet, and TVs and speakers can be placed anywhere without worrying how far the cable will go. The new generation of ultra wideband chipsets coming to market means the ability of consumer electronics companies to deliver on this vision is just around the corner."

"As multimedia distribution reaches into the home, service providers have an opportunity to extend their offerings beyond the cable or satellite connection and deliver wirelessly networked services throughout the household," said Nicole Klein, analyst for the Yankee Group. "The enabling technology for delivering this new suite of services resides in ultra wideband chipsets with the speed, reliability and non-line-of-site reach to transmit high quality audio and video wirelessly, no matter where consumers locate their PCs and home entertainment systems."

Today, only the Tzero TZ 7000 chipset solution has non-line-of-site operation, which enables devices to communicate wirelessly through walls to extend across multiple rooms. It also features performance up to 10 million times greater than other wireless networks and transmission speeds of up to 480 Mbits per second to support even the highest demands of broadcast-quality video. Able to carry three or more high-definition video streams across a 20-meter range while running at 100Mbits per second, only Tzero supports a completely wireless network that can easily connect multiple devices throughout the home or office at the same time.

Tzero Defines the Standard
The following chart shows how Tzero meets or exceeds all the requirements set forth by Panasonic, Philips, Samsung, Sony, and Sharp during a presentation to the IEEE in 2003.

Attribute	CE Requirements	Data Networking (WiFi) Requirement	Tzero Performance
Link reliability	95 to 98+%	90%	>>99%
Packet error rate	10^{-8}	8%	10^{-8}
Packet errors per 120-minute HD movie	Less than 1	7,659,574	Less than 1
Interference robustness	Desirable, but no specific requirement	Not considered	-10 dB
Data rate and range	>100 Mbps @ 10m LOS	11 Mbit @ 15m NLOS[1]	108.7 Mbps @ 15-30m NLOS[2]

1) PC World Magazine, July 2006.
2) Non line-of-sight, including through walls.

Tzero UWB Chipset and Reference Design Features
The Tzero TZ 7000 UWB offering is a complete chipset solution designed to help original equipment manufacturers (OEMs) and original design manufacturers (ODMs) bring ultra wideband wireless applications for the consumer electronics, PC and peripherals markets quickly and cost effectively. It offers networked connectivity through a ubiquitous IP network, which allows for any-device-to-any-device wireless communication. Supporting the WiMedia Alliance UWB standard, the Tzero solution provides the performance required for real-time video delivery. It also avoids interference from other devices – both in-band (other UWB devices, WiMax, etc.) and out-of-band (microwave ovens, cordless phones, WiFi networks, etc.) which has affected other forms of wireless networks.

An optimized, two-chip standard CMOS chipset, the Tzero TZ 7000 solution is a complete wireless subsystem that consists of:

- TZ 7110 integrated Baseband mixed-signal system-on-a-chip (SoC), including both the physical (PHYs) and medium access control (MAC) layers
- TZ 7210 state-of-the-art radio frequency (RF) chip
- Single and multiple antenna solutions optimized for cost and performance
- Embedded firmware and application software support for Windows, Linux and other host operating systems

The Tzero chipset solution is complemented by Tzero's UWB Mini-PCI reference design, which speeds the time-to-market launch of ultra wideband-based audio/video systems for wirelessly connecting consumer electronic devices – such as DVD recorders/players, set-top boxes, digital media adapters or PCs – to displays such as televisions (standard definition or high-definition), projectors, and monitors. The reference design uses IP connectivity to enable multiple peer-to-peer connections and supports both single- and multiple-antenna configurations. The Tzero UWB Mini-PCI reference design is available in PCI, Mini-PCI, and PC formats.

"Consumer electronics companies recognize the tremendous market potential for wireless networks that can connect everything in the home or office – even devices with the most demanding video and audio needs," said Rajeev Krishnamoorthy, founder and chief technology officer, Tzero. "To address that opportunity, we've used the requirements outlined by some of the world's leading CE manufacturers as the product specifications for our UWB chipset solution and reference design. The result is the industry's only complete all-wireless IC solution for delivering broadcast-quality video at optimal speed and without interruption."

Availability
Production availability of the TZ 7000 UWB chipset solution and Tzero UWB Mini-PCI reference design begins July 2006.

About Tzero Technologies, Inc.
Tzero Technologies is the only IC supplier that enables broadcast quality video over wireless networks. Tzero transforms the entire home entertainment system into an easy-to-install wireless network that delivers HD quality video, anywhere. Founded in 2003, Tzero is backed by tier-one venture partners, including August Capital, Lightspeed Venture Partners, USVP and VentureTech Alliance. Tzero is headquartered in Sunnyvale, Calif. For more information, visit Tzero online at www.Tzerotech.com.

###

PR Contact:
Teena Touch
Blanc & Otus
415.856.5128
ttouch@blancandotus.com

ADDENDUM: Industry comments on Tzero Technologies:

"There is a huge market need right now for wireless distribution of high-quality video throughout the home. Tzero Technologies promises all consumers the capability of wireless distribution of multi-channel high-definition home theater from any room in the home, to any other. The consumer electronics OEMs in Korea are anxious for this solution, and in the end, it will be a strong differentiator for the ones which rapidly adopt this technology."
JK Hong, president and CEO, FM.COM Corp.

"Consumer electronics OEMs and consumers alike have been looking for a wireless connectivity solution that provides the same user experience (quality, reliability and performance) as wired solutions. The Tzero Technology UWB products seem to meet all these requirements. Adding wireless to a CE product is always challenging but by cooperating with Tzero, our joint platforms should offer significant advantages in platform simplicity, performance and cost."
Dave Pederson, vice president corporate marketing, Zoran

"Establishing exacting quality and reliability standards is critical as the market for UWB wireless multimedia connectivity evolves from the technology development stage to volume production. Test equipment from Tektronix and our work with Tzero will enable product development teams to speed time-to-market for UWB-based wireless consumer products."
Colin Shepard, vice president, performance oscilloscopes, Tektronix

"Tzero Technologies has demonstrated extraordinary performance of UWB enabling wireless transmission of High-Definition video streams. Tzero's innovative UltraMIMO technology, together with OMRON Corporation's unique, free-shape antenna technology, enables a very compelling wireless solution for consumers of High Definition entertainment that meet consumer thresholds for cable replacement. We have been working very closely with Tzero to further integrate this solution and satisfy the needs of global consumer electronics manufacturers."
Thomas Kurian, vice president, new technologies & markets, OMRON Advanced Systems, Inc.

"Our customers have asked us for a high-quality, cost-effective means for delivering high- definition content to consumer equipment wirelessly. We believe the Tzero solution provides what our customers need and that the Tzero products will play a leading role in enabling next generation of wireless connectivity."
Gabi Hilevitz, CEO, CopperGate

"The customers for our high definition audio and video compression/decompression products are on a quest to find a wireless networking solution which enables broadcast quality video. By working with Tzero Technologies we jointly provide broadcast quality video without wires, best-in- class compression/decompression technology and rapid time to market with our reference design."
Kari Waters, director of strategic marketing, Micronas USA, Inc.

"UWB is an important technology for accessing additional spectrum worldwide and for moving traffic that traditional narrow band links can't. Just as WiFi has proven to be explosively high growth for wireless data networking, UWB will achieve similar growth for applications like high- definition video networking. Utilizing wide spectrum bands is sometimes the only practical way to provide robustness at high bandwidths. By focusing on the areas where UWB links make their greatest technical contributions, Tzero has built uniquely upon these advantages to deliver a product that meets the requirements of consumer electronics manufacturers now and for the foreseeable future."
Andy Rappaport, general partner with August Capital

Back to Press Releases

2006 Copyright Tzero Technologies. All Rights Reserved.

Exhibit 9

Press Releases

Press Releases

Recent News

Events

Awards

See our video demonstration

Visit our Ultra Wideband Blog >

the Tzero mailing list

Back to Press Releases

Leading Set-Top Box and Residential Gateway Suppliers Align Around Ultra Wideband for Next-Gen Products

DALLAS, TEXAS. – November 6, 2006 – Ultra wideband (UWB) solutions continue to gain momentum this week at the TelcoTV Conference and Exhibition with a range of leading set-top box, residential gateway and network digital video recorder manufacturers – including Amedia (OTC BB: AANI), Complete Media Systems, Entone Technologies, Magnum Semiconductor, Siemens Home and Office Communication Devices and UTStarcom – demonstrating and introducing advanced video solutions using technology from Tzero Technologies. The offerings created by these organizations and others will help accelerate the adoption of high-definition and IPTV services, ease and speed the installation of these services in the home, and drive significant differentiation for service providers around the world.

"The availability of ultra wideband-based solutions for connecting consumer electronics throughout a home is a critical step in the current evolution of networking and entertainment," said Ben Bajarin, analyst with Creative Strategies. "This high-bandwidth connectivity will let service providers offer seamless solutions for bringing a range of new video services – IPTV, video on demand, online gaming, music and movies – from a single gateway or similar device to any display anywhere in the home without the need for new wiring, driving down costs and raising average revenue per subscriber."

Tzero is the leading supplier of UWB solutions including those for high-definition video applications. The company's advanced technology can connect a range of A/V components – displays, set-top boxes, digital video recorders, media center PCs, residential gateways and more. Unlike proprietary offerings, Tzero's platform is based on standards from the WiMedia Alliance and is guaranteed to coexist with other WiMedia-compliant devices.

"Tzero is the only company now delivering a high-bandwidth solution that can easily handle multiple video streams and deliver them throughout a home," said Mike Gulett, president and CEO of Tzero. "The addition of Tzero's UWB technology to our customers' offerings enables them to provide an exceptional value in the marketplace, and service providers adopting these solutions will be able to quickly differentiate themselves, gain consumer mindshare, and increase market-share."

Manufacturing and Design Partners
In addition to working with the major set-top box and gateway providers, Tzero is also enabling a number of major original design manufacturers to support ultra wideband solutions. The first of these are AboCom, Arcadyan Technology Corporation and Acustek Computer, Inc.

AboCom is one of the top providers of mobile computing products and high-speed Internet access solutions targeted at the small office/home office marketplace. The company will work with Tzero to address the growing demand for UWB modules in the telecommunications and other markets.

Acustek is the world's largest producer of computer mother boards and a leading manufacturer of wireless products including cell phones, WiFi routers and access points. The company will be working jointly with Tzero and its customers to design and develop innovative and low-cost UWB-based offerings for the service provider marketplace.

Arcadyan is one of the top providers of wireless products including ADSL/IAD solutions, 802.11 access points/gateways, wireless home A/V platforms and wireless modules. Arcadyan is working with Tzero to deliver residential gateways and other products for companies around the world.

Availability
Tzero's ultra wideband products are available now for evaluation. Visit www.tzerotech.com or call (408) 328-5000 for more information. Pricing is available upon request.

About Tzero Technologies, Inc.
Tzero Technologies is the leader in wireless video. The company's advanced ultra wideband technology can connect a range of A/V components – displays, set-top boxes, digital video recorders and more – without cabling throughout the home. Founded in 2003, Tzero is backed by tier-one venture partners, including August Capital, Lightspeed Venture Partners, Miven Venture Partners, DVP, USVP and VentureTech Alliance. Tzero is headquartered in Sunnyvale, Calif. For more information, visit Tzero online at www.tzerotech.com.

###

PR Contact:
Layla McHale
for Tzero Technologies
408-981-8394
lmchale@pacbell.net

Matt Keowen
Tzero Technologies, Inc.
408-328-5000
matt.keowen@tzerotech.com

Back to Press Releases

2006 Copyright Tzero Technologies. All Rights Reserved.

Watch Wireless HD
See our video demonstration

Visit
our Ultra Wideband Blog >

Join
the Tzero mailing list

Press Releases

Back to Press Releases

Tzero Ultra Wideband Technology Recognized as Top Product by EDN Magazine

Company's UWB Chipset for High-Definition Video Distribution throughout the Home Continues to Build Industry Momentum

SUNNYVALE, CALIF. – February 14, 2007 – Tzero Technologies, the leader in ultra wideband (UWB) for video distribution, today announced its chipset has been named as one of EDN Magazine's "Hot 100 products of 2006." According to EDN, the list "distills the most innovative and significant products of the year." This award is one of many received by Tzero recently, including two Innovations Awards from the Consumer Electronics Association in January. And Tzero and ultra wideband have also been recognized as being one of the most important "technologies to watch" in 2007.

UWB is being adopted by consumer electronics and service providers in response to increasing consumer demand for the flawless delivery of high-definition video, anywhere in the home. Unlike other offerings, Tzero's UWB is the only technology that can function wirelessly and over existing home wiring to create a whole home entertainment network. Tim Bajarin, principal analyst at Creative Strategies and columnist with PC Magazine, recently wrote that wireless high-definition and UWB will be one of the hottest themes this year, "since it represents a key to the future for content distribution within the home."

At CES 2007 last month, more than 20 leading consumer electronics manufacturers, including Audiovox, Gefen, Siemens, Stonestreet One, ViewSonic and others, demonstrated Tzero UWB-enabled products. "Tzero's UWB solution for delivering high-definition video is a breakthrough technology and is one of the keys to our strategy for a completely wireless living room," said Hank Caskey, Vice President, Accessories Group, Audiovox Corporation. "With other UWB applications coming into the home, Tzero's standards based approach is critical for the long term success of this product category and a key reason we are partnering with them."

The increased need for streaming high definition video coupled with the capabilities of UWB, have leading wireless publications, including Wireless Week and WirelessNetDesignLine, predicting 2007 to be the "year of UWB."

"The market for ultra wideband has developed rapidly in the past year, especially among consumer electronics companies and service providers. They are all searching for a solution to distribute high-definition video around the home," said Mike Gulett, president and CEO of Tzero Technologies. "UWB's unique ability to function both wired and wirelessly is driving its adoption so quickly; we expect UWB to be the market standard living room and whole-home video networking."

About Tzero Technologies, Inc.
Tzero Technologies is the leader in ultra wideband for video distribution. The company's advanced ultra wideband technology can connect a range of A/V components – displays, set-top boxes, digital video recorders and more – without cabling throughout the home. Founded in 2003, Tzero is backed by tier-one venture partners, including August Capital, Lightspeed Venture Partners, Miven Venture Partners, OVP, USVP and VentureTech Alliance. Tzero is headquartered in Sunnyvale, Calif. For more information, visit Tzero online at www.tzerotech.com.

PR Contact:
Layla McHale
for Tzero Technologies
408-981-6394
lmchale@pacbell.net

Matt Keowen
Tzero Technologies, Inc.
408-328-5000
matt.keowen@tzerotech.com

Tzero, Tzero Technologies and the Tzero logo design are trademarks or registered trademarks of Tzero Technologies. All other marks are the property of their respective owners and are used here only for identification purposes.

Back to Press Releases

2006 Copyright Tzero Technologies. All Rights Reserved.

UNITED STATES
DISTRICT COURT
SOUTHERN DISTRICT OF CALIFORNIA
SAN DIEGO DIVISION

145843 - BH

December 21, 2007
16:35:15

Civ Fil Non-Pris
USAO #.: 07CV2407 CIVIL FILING
Judge..: JOHN A HOUSTON
Amount.: $350.00 CK
Check#.: BC# 65407

Total-> $350.00

FROM: CIVIL FILING
PULSE-LINK V. TZERO TECH.

JS 44 (Rev. 11/04)

CIVIL COVER SHEET

The JS 44 civil cover sheet and the information contained herein neither replace nor supplement the filing and service of pleadings or other papers as required by law, except as provided by local rules of court. This form, approved by the Judicial Conference of the United States in September 1974, is required for the use of the Clerk of Court for the purpose of initiating the civil docket sheet. (SEE INSTRUCTIONS ON THE REVERSE OF THE FORM.)

'07 CV 2407 JAH AJB

I. (a) PLAINTIFFS
PULSE~LINK INCORPORATED

DEFENDANTS
TZERO TECHNOLOGIES INCORPORATED

07 DEC 21 PM 4:29

(b) County of Residence of First Listed Plaintiff San Diego
(EXCEPT IN U.S. PLAINTIFF CASES)

County of Residence of First Listed Santa Clara
(IN U.S. PLAINTIFF CASES ONLY)
NOTE: IN LAND CONDEMNATION CASES, USE THE LOCATION OF THE LAND INVOLVED.

(c) Attorney's (Firm Name, Address, and Telephone Number)
John M. Benassi (SBN 74137); Matthew C. Lapple (SBN 193546)
Samuel R. Hellfeld (SBN 234421)
Heller Ehrman LLP
4350 La Jolla Village Drive, 7th Floor
San Diego, CA 92122-1246

Attorneys (If Known)

BY: DEPUTY

II. BASIS OF JURISDICTION (Place an "X" in One Box Only)

- ☐ 1 U.S. Government Plaintiff
- ☒ 3 Federal Question (U.S. Government Not a Party)
- ☐ 2 U.S. Government Defendant
- ☐ 4 Diversity (Indicate Citizenship of Parties in Item III)

III. CITIZENSHIP OF PRINCIPAL PARTIES (Place an "X" in One Box for Plaintiff and One Box for Defendant) (For Diversity Cases Only)

	PTF	DEF		PTF	DEF
Citizen of This State	☐ 1	☐ 1	Incorporated or Principal Place of Business In This State	☐ 4	☐ 4
Citizen of Another State	☐ 2	☐ 2	Incorporated and Principal Place of Business In Another State	☐ 5	☐ 5
Citizen or Subject of a Foreign Country	☐ 3	☐ 3	Foreign Nation	☐ 6	☐ 6

IV. NATURE OF SUIT (Place an "X" in One Box Only)

CONTRACT: ☐ 110 Insurance; ☐ 120 Marine; ☐ 130 Miller Act; ☐ 140 Negotiable Instrument; ☐ 150 Recovery of Overpayment & Enforcement of Judgment; ☐ 151 Medicare Act; ☐ 152 Recovery of Defaulted Student Loans (Excl. Veterans); ☐ 153 Recovery of Overpayment of Veteran's Benefits; ☐ 160 Stockholders' Suits; ☐ 190 Other Contract; ☐ 195 Contract Product Liability; ☐ 196 Franchise

REAL PROPERTY: ☐ 210 Land Condemnation; ☐ 220 Foreclosure; ☐ 230 Rent Lease & Ejectment; ☐ 240 Torts to Land; ☐ 245 Tort Product Liability; ☐ 290 All Other Real Property

TORTS — PERSONAL INJURY: ☐ 310 Airplane; ☐ 315 Airplane Product Liability; ☐ 320 Assault, Libel & Slander; ☐ 330 Federal Employers' Liability; ☐ 340 Marine; ☐ 345 Marine Product Liability; ☐ 350 Motor Vehicle; ☐ 355 Motor Vehicle Product Liability; ☐ 360 Other Personal Injury

PERSONAL INJURY: ☐ 362 Personal Injury— Med. Malpractice; ☐ 365 Personal Injury — Product Liability; ☐ 368 Asbestos Personal Injury Product Liability

PERSONAL PROPERTY: ☐ 370 Other Fraud; ☐ 371 Truth in Lending; ☐ 380 Other Personal Property Damage; ☐ 385 Property Damage Product Liability

CIVIL RIGHTS: ☐ 441 Voting; ☐ 442 Employment; ☐ 443 Housing/ Accommodations; ☐ 444 Welfare; ☐ 445 Amer. w/Disabilities - Employment; ☐ 446 Amer. w/Disabilities - Other; ☐ 440 Other Civil Rights

PRISONER PETITIONS: ☐ 510 Motions to Vacate Sentence; Habeas Corpus: ☐ 530 General; ☐ 535 Death Penalty; ☐ 540 Mandamus & Other; ☐ 550 Civil Rights; ☐ 555 Prison Condition

FORFEITURE/PENALTY: ☐ 610 Agriculture; ☐ 620 Other Food & Drug; ☐ 625 Drug Related Seizure of Property 21 USC 881; ☐ 630 Liquor Laws; ☐ 640 R.R. & Truck; ☐ 650 Airline Regs.; ☐ 660 Occupational Safety/Health; ☐ 690 Other

LABOR: ☐ 710 Fair Labor Standards Act; ☐ 720 Labor/Mgmt. Relations; ☐ 730 Labor/Mgmt.Reporting & Disclosure Act; ☐ 740 Railway Labor Act; ☐ 790 Other Labor Litigation; ☐ 791 Empl. Ret. Inc. Security Act

BANKRUPTCY: ☐ 422 Appeal 28 USC 158; ☐ 423 Withdrawal 28 USC 157

PROPERTY RIGHTS: ☐ 820 Copyrights; ☐ 830 Patent; ☐ 840 Trademark

SOCIAL SECURITY: ☐ 861 HIA (1395ff); ☐ 862 Black Lung (923); ☐ 863 DIWC/DIWW (405(g)); ☐ 864 SSID Title XVI; ☐ 865 RSI (405(g))

FEDERAL TAX SUITS: ☐ 870 Taxes (U.S. Plaintiff or Defendant); ☐ 871 IRS—Third Party 26 USC 7609

OTHER STATUTES: ☐ 400 State Reapportionment; ☐ 410 Antitrust; ☐ 430 Banks and Banking; ☐ 450 Commerce; ☐ 460 Deportation; ☐ 470 Racketeer Influenced and Corrupt Organizations; ☐ 480 Consumer Credit; ☐ 490 Cable/Sat TV; ☐ 810 Selective Service; ☐ 850 Securities/Commodities/ Exchange; ☐ 875 Customer Challenge 12 USC 3410; ☒ 890 Other Statutory Actions; ☐ 891 Agricultural Acts; ☐ 892 Economic Stabilization Act; ☐ 893 Environmental Matters; ☐ 894 Energy Allocation Act; ☐ 895 Freedom of Information Act; ☐ 900 Appeal of Fee Determination Under Equal Access to Justice; ☐ 950 Constitutionality of State Statutes

V. ORIGIN (Place an "X" in One Box Only)
☒ 1 Original Proceeding; ☐ 2 Removed from State Court; ☐ 3 Remanded from Appellate Court; ☐ 4 Reinstated or Reopened; ☐ 5 Transferred from another district (specify); ☐ 6 Multidistrict Litigation; ☐ 7 Appeal to District Judge from Magistrate Judgment

ORIGINAL

VI. CAUSE OF ACTION
Cite the U.S. Civil Statute under which you are filing (Do not cite jurisdictional statutes unless diversity):
Lanham Act § 43(a), 15 U.S.C. § 1125(a), 15 U.S.C. § 1121.
Brief description of cause:
Tzero has engaged in false and deceptive advertising, unfair competition and other unlawful and deceptive business practices in violation of Lanham Act and California statutory and common law.

VII. REQUESTED IN COMPLAINT: ☐ CHECK IF THIS IS A CLASS ACTION UNDER F.R.C.P. 23 **DEMAND $**
CHECK YES only if demanded in complaint: **JURY DEMAND:** ☒ Yes ☐ No

VIII. RELATED CASE(S) IF ANY (See instructions): JUDGE LORNEZ and JUDGE MOSKOWITZ DOCKET NUMBER 07CV1125 and 07CV2156

DATE December 21, 2007
SIGNATURE OF ATTORNEY OF RECORD

FOR OFFICE USE ONLY
RECEIPT # 145873 AMOUNT $350 12/21/07 BH APPLYING IFP JUDGE MAG. JUDGE